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OUR FIELDS.

By E. W. Prevost.

IT is not probable that very many of the readers of Knowledge have ever thought, when walking through the fields, how those fields came to be in the condition in which they now are; not as regards the crops which they bear, but as regards the fine powdery state of the earth, when below are only to be found hard rocks. We do not propose to enter into the question why the rocks below occupy their present position, but rather to consider some of the means whereby rocks generally have yielded, and still do yield, a material different in character to themselves, and one suited to the growth of plants. For simplicity's sake we will assign the origin of a soil to two rocks known as Granite or Trap; for although a soil is not wholly nor directly derived from these two, yet the changes, such as those experienced by granite and trap, are the same in character, though differing in degree, in whatever be the rock under consideration.

Granite, a substance produced by the agency of heat in the early geological ages, is a mixture of three different minerals—quartz, a white lustrous mineral, also known in certain forms as rock-crystal, felspar, and mica. Felspar, of which there are several kinds, is a silicate of the metal aluminium, together with the silicates of potash, lime, or soda, according to the variety of felspar. Mica appears in the form of small bright shining scales, and is a silicate of potash or magnesia. Together with these three minerals, which may be called the elements of the soil, there are always present small quantities of other substances, such as iron, &c.

The trap rocks, divisible into two great classes, called diorite and dolerite, contain soda, lime, magnesia, and potash; and phosphoric acid is also present, but not to a large extent. Here, then, we have the materials necessary for the formation of soil, but its quality is dependent not only on the composition of the minerals contained in the rocks, but also upon the proportion in which they have contributed their constituent parts. The first agency to which the disintegration of a rock is due, reducing it from the original massive condition to that of a powder, is frost in conjunction with water. Most persons must be well aware of the fact that when water freezes, it expands to a considerable extent at the moment of solidifying, and that this expansion is irresistible, the vessels enclosing the water being destroyed. This same irresistible force is continually at work during the winter, destroying the cliffs on the sea-shore and inland; for there are always a number of clefts or fissures that admit of the entrance of water, which, when the temperature is low enough, is there frozen, and in freezing expands and splits the stone: and then, if the position be favourable, this splinter from the main rock falls down as soon as the ice melts, in consequence of a rise of the temperature. Again, the alternations of heat and cold, without the intervention of water, produce rifts, because the rock, being composed of substances which are not affected to the same extent by the same rise of temperature, expands unequally, and the result is the separation of the parts from one another. It is thus that the beds of torrents, rushing down glens, are in part filled by stones of various sizes, which, raising the level of the bed at the same time by their removal from the banks, alter the character of the glen. Even before the boulders become detached from the cliff, they are subjected to a slow but sure process of destruction, for every drop of rain which beats against the bare stone has its effect in wearing the surface away. In these processes of destruction we recognise mechanical agencies: but this is not all; chemistry plays also a very important part in reducing a block of stone to powder. The rain, in falling through the air, dissolves some of the oxygen and carbonic acid gas which it contains, and then, when this rain, holding carbonic acid in solution, comes in contact with the rock, a part of the more soluble portions is dissolved. It is, therefore, evident that the rain is a very powerful destroyer of stone, in that it works in two distinct ways—mechanically, whereby the rock is powdered, and chemically, whereby a part is carried away in solution.

Now, let us see what is the result of this partial solution of an apparently insoluble material. In the case of granite, bearing in mind that there are at least three different substances present, which are firmly and solidly mixed together, simple powdering would result in a separation from one another of the quartz, felspar, and mica; and if a current of water be passing over the rock at the time, the heavier particles would be left behind and the lighter ones would be swept away. This is what actually occurs: the quartz, finally known as sand, is left behind, while the lighter particles of felspar and mica are removed; now, seeing that the water, whether rain or river, contains carbonic acid, the felspar is slowly acted upon by the acid, is decomposed into silicate of alumina, and potash, which passes into solution, while the silicate of alumina remains behind or suspended in the water, and is now known as clay. As for the mica, it is not easily affected chemically, and may either be left behind with the clay, or, if the stream be rapid, it is carried away and deposited elsewhere. Such a process as is here described explains the destruction of a rock, and the consequent formation of beds of sand and clay, which are ill-fitted for the growth of plants, and to explain this we pictured to ourselves the rock in its original position, and undergoing all the processes at one time. To account for the production of loam, it is not necessary that every process should occur at once; but rather that, firstly, the boulder, removed by frost from the main rock, should be further broken up in the bed of a stream, and the particles so produced be then carried down by the stream and deposited where the current is less swift; this deposit, in time, becomes bare of water, as the stream alters its course, and finally becomes dry land. Now our new soil is not yet fit for plants, and as it consists of particles of the

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original rock, it will, if subjected to the same influences, yield the same products when decomposed; lying exposed, as it does, to the rain and air, the slow changes above described take place, and we finally have a mixture of sand, clay, potash, lime, &c. To aid this slow action, which at the present day is not yet complete, the farmer ploughs his field, which, bringing up fresh soil from below, exposes it to the air and rain. We have before stated that the fertility of a soil is dependent upon the minerals of the soil and the extent of their decomposition. If, therefore, no aid is given to the solvent action of rain by ploughing, no great amount of fertility can be expected. The variety of felspar, whether it be a soda or a lime felspar, is of great importance—the second kind, when decomposed, producing tolerably fertile land, the former not so. When mica is present in large quantities, extreme infertility is the result, and for reasons before stated. It would occupy too much space to allude to all the various circumstances productive of the various classes of soils, and we therefore proceed to account for the production of the humus, or vegetable matter, which generally gives the dark colour, for a soil destitute of humus would be of varying shades of yellow and red. It has been proved by experiment that plants can grow without humus, or vegetable mould, and we need only refer to the growth of lichens on stones, &c., as an example; therefore, the first crop which grew on the new soil, whatever that crop or its origin might be, would flourish to a certain extent, and, dying, leave its remains behind; these would render the growth of the next generation of plants more vigorous; these, in their turn dying, the supply of humus would gradually increase. It might be supposed that the formation of humus would in time become excessive, but, as a rule, this is not so, because humus gradually decomposes, and in decomposing supplies carbonic acid to the soil, so aiding in the decomposition of the minerals present. In all these changes we see the marvellous usefulness of that gas which, under certain circumstances, is so fatal to man; but here we find it as a most useful servant, for not only does it supply air-food to the plant, being absorbed by the leaves, but, entering into the earth with the rain, it there prepares that food which the plant must have, and which it absorbs by its roots.

COMETS AND COMETS' TAILS.

By the Editor.

BEFORE we proceed to consider the theory by which alone, so far as can be judged at present, the phenomena of comets' tails can be explained, it may be well that we should consider the evidence derived from other comets than those hitherto considered.

In the first place we would direct special attention to the comet of 1811. In this comet, as may be seen from its picture in Fig. 1, the various parts of the comet and its tail could be distinguished by the naked eye. There was the condensed part, called the *nucleus*, which in this case was apparently globular in form; the nebulous envelope which surrounds the nucleus, the so-called *coma;* the bright side parts of the tail where it seems to be swept away from the coma, leaving a comparatively dark region behind the head, and the tail, widening and growing fainter with distance from the head. No one, we think, who considers this picture will for a moment imagine that the comet is a mere lens, and its tail merely the track of light condensed by this lens along the region behind the head. Here, again, the hollow structure of the tail seems indicated by the bright tracks on either side, though, as we shall endeavour to show later, the exceedingly well-defined nature of the dark track behind the nucleus in many comets seems to force upon us a different interpretation of this singuiar and characteristic feature.

In some respects the comet of 1811 tells us more of cometic possibilities, so to speak, than any other comet that has ever yet been observed. Discovered on March 26, 1811, this comet remained visible for a longer time than any yet seen, viz., for 16 months, 22 days. It had a tail 120 millions of miles in length, and 15 millions of miles in diameter at the widest part. The diameter of the nucleus was about 127,000 miles, that of the envelope round the head about 643,000 miles. But what was so remarkable about this comet was, that it obtained this remarkable development without approaching the sun, as other comets have done. The usual rule with comets is that the nearer they approach to the sun, the more their heads and tails are developed. But the least distance of the comet of 1811 from the sun was little less than 100 millions of

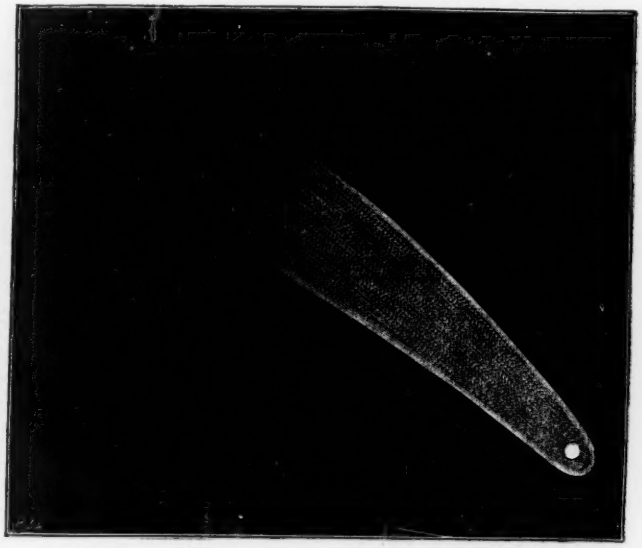

Fig. 1. Comet of 1811.

miles. Again, although it made so remarkable an appearance, as seen from the earth, the distance of that comet from us was at no time less than 110 millions of miles. Its true magnitude, therefore, as Professor Kirkwood well remarks, "has probably not been surpassed by that of any other comet which has yet been observed." If its path had carried it nearer to the sun, its appearance would probably have been terrible in the extreme. If we consider the enormous volume occupied by this comet and its tail, its

> Million cubic miles of head,
> Ten billion leagues of tail,

we shall see that the phenomena we have to interpret ought not to escape us in virtue of minuteness of scale.

Next consider the great comet of 1861. This comet was discovered on May 13, by Mr. John Tebbutt, jun., of New South Wales, and first accurately observed at the Sydney Observatory, on May 26. It passed northwards from the southern skies, and first became visible in Europe in the last week of June, 1861. The first recorded obser-

vations were made on the evening of June 30, nineteen days after it had passed its point of nearest approach to the sun. We remember well observing it on the morning of July 2, 1861. For some reason, we found it impossible to sleep that morning, and getting up about three in the morning (the exact hour we do not remember, but it must have been very early), we saw in the east what looked at first like the rays of an aurora borealis. But presently we noticed that these rays proceeded (unlike those of the aurora) from a bright centre, which had been hidden by clouds when our observations began. We used at that time to keep a four-inch telescope, mounted on a three-legged stand, in our bedroom. This we had quickly ready for action (noting that the object, owing to the approach of sunrise, was getting fainter every minute), and turning it on the comet, we drew a picture of the nucleus and coma so closely resembling that which appeared a week or two later in the *Illustrated London News*, that we might have supposed our picture had been surreptitiously sent to the office of the *Illustrated*, had we not found it resting just where we had put it in our scientific portfolio.

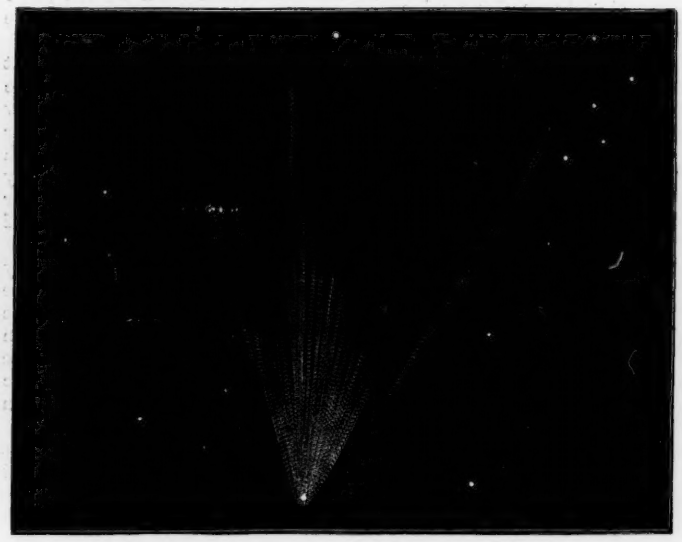

Fig. 2.

The comet appeared to the eye as shown in Fig. 2. Sir John Herschel, who observed it at Collingwood, in Kent, remarked that it was far more brilliant than any comet he had ever seen, not even excepting those of 1811 and 1858. The Padre Secchi, at Rome, found that in the clear skies of Italy the tail was fully 118° in length, corresponding to nearly one-third more than the distance between the horizon and the point overhead. This comet, by the way, though only favourably visible for a very short time, remained within the range of telescopic vision much longer. Hind remarks that the number of separate observations for the determination of its orbit exceeds 1,150, and extend over a period of 11½ months. It travelled on a course favouring observation, coming from remote distances south of the plane in which the earth travels to the northern side of that plane—and as it chanced, crossing the plane (about five-sixths of the way from the sun to the earth's orbit) just when the earth lay in the same direction from the sun, so that for a time she was within the bounds of the comet's tail-like appendage—and then travelling northwards on a path almost at right angles to the plane of the ecliptic. Thus the comet could be tracked on its retreat until, finally, distance concealed it from our view.

Now, the tail of the comet of 1861, as seen in Fig. 2, had something of the fan-like expansion observed in the tail of the comet of 1744; but what was known of the comet's position at the time when this fan-like form was seen, explained the peculiarity, and showed the necessity of taking into account the position of a comet before attaching undue importance to the apparent figure of its tail. For the fan-like form seen on this occasion was a mere effect of perspective. The end of the tail appeared very much wider than the part near the head—not that it really was so, but simply because it was very much nearer to the observer on earth. When we were actually immersed in the tail, the part nearest to us, being all round, had, to all intents and purposes, an infinite extension. But even when the comet was beyond that position, or a few days earlier, before it had reached it, the end of the tail was much nearer to us than the comet's head, and thus appeared far more proportionately widened than was actually the case.

Such considerations must always be taken into account in dealing with cometic phenomena. Comets, more than any other celestial objects (the Milky Way, regarded as a whole, being, perhaps, alone excepted), are affected in shape, and apparently, even in their very nature, by position, and consequent foreshortening.

SOLIDS, LIQUIDS, AND GASES.

By W. Mattieu Williams.

PART III.

THAT the solid and liquid states of matter are not distinctly and broadly separable, but are connected by an intermediate condition of viscosity, which is more or less common to both, has, I think, been sufficiently shown in the previous papers, and the proofs of this are familiar enough.

We now come to the question whether there is any similar continuity between liquids and gases. Ordinary experience decidedly suggests a negative answer. We can point to nothing within easy reach that has the properties of liquid and gaseous half-and-half; that stands between gases and liquids as pitch and treacle stand between solids and liquids.

Some, perhaps, may suggest that cloud-matter—London fog, for example—is in such an intermediate state. This, however, is not the case. White country fog, ordinary clouds, or the so-called "steam" that is seen assuming cloud-forms as it issues from the spout of a tea-kettle or funnel of a locomotive, consist of minute particles of water suspended in air, as solid particles of dust are also suspended. It has been called "vesicular vapour," on the supposition that it consists of minute vesicles, like soap-bubbles on a very small scale, but this hypothesis remains unproven. London fog consists of similar particles, varnished with a delicate film of coal-tar, and interspersed with particles of soot.

In order to clearly comprehend this question, we must define the difference between fluids and gases. In the first place, they are both fluids, as already agreed. What,

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then, is the essential difference between liquid fluidity and gaseous fluidity? The expert in molecular mathematics, discoursing to his kinematical brethren, would produce a tremendous reply to this question. He would describe the oscillations, gyrations, collisions, mean free paths, and mutual obstructions of atoms and molecules, and, by the aid of a maddening array of symbols, arrive at the conclusion that gases, unless restrained, are liable to indefinite or vast expansion, while liquids, of their own accord, retain definite limits or dimensions.

The matter-of-fact experimentalist demonstrates the same by methods that are easily understood by anybody. I shall, therefore, both for my own sake and my reader's, describe some of the latter.

In the first place, we all see plainly that liquids have a surface, *i.e.*, a well-defined boundary, and also that gases, unless enclosed, have not. But as this may be due to the invisibility of the gas, we must question it further. The air we breathe may be taken as a type of gases, as water may of liquids. It has weight, as we may prove by weighing a bottle full of air, then pumping out the contents, weighing the empty bottle, and noting the difference.

Having weight, it presses towards the earth, and is squeezed by all that rests above it, and thus the air around us is constrained air. It is very compressible, and is accordingly compressed by the weight of all the air above it.

This being understood, let us take a bottle full of water and another full of air, and carry them both to the summit of Mont Blanc, or to a similar height in a balloon. We shall then have left nearly half of the atmosphere below, and thus both liquid and gas will be under little more than half of the ordinary pressure. What will happen if we uncork them both? The liquid will still display its definite surface, and remain in the bottle, but not so the gas. It will overflow upwards, downwards, or sideways, no matter how the bottle is held, and if we had tied an empty bladder over the neck before uncorking, we should find this overflow or expansion of the gas exactly proportionate to the removal of pressure, provided the temperature remained unaltered. Thus, at just half the pressure under which a pint bottle was corked, the air would measure exactly one quart, at one-eighth of the pressure one gallon, &c.

We cannot get high enough for the latter expansion, but can easily imitate the effect of further elevation by means of an air-pump. Thus, we may put one cubic inch of air into a bladder of 100 cubic inches capacity, then place this under the receiver of an air-pump, and reduce the pressure outside the bladder to $\frac{1}{100}$th of its original force. With such atmospheric surrounding, the one cubic inch of air will plump out the flaccid bladder, and completely fill it. The pumpability of the air from the receiver shows that it goes on overflowing from it into the piston of the pump as fast as its own elastic pressure on itself is diminished.

Numberless other experiments may be made, all proving that all gases are composed of matter which is not merely incohesive, but is energetically self-repulsive; so much so, that it can only be retained within any bounds whatever by means of some external pressure or constraint. For aught we know *experimentally*, the gaseous contents of one of Mr. Glaisher's balloons would outstretch itself sufficiently to occupy the whole sphere of space that is spanned by the earth's orbit, provided that space were perfectly vacuous, and the balloon were burst in the midst of it, and the temperature of the expanding gas were maintained.

Here, then, in this self-repulsiveness, instead of self-cohesion, this absence of self-imposed boundary or dimensions, we have a very broad and well-marked distinction between gases and liquids, so broad that there seems no bridge that can possibly cross it. This was believed to be the case until recently. Such a bridge has, however, been built, and rendered visible, by the experimental researches of Dr. Andrews; but further explanation is required to render this generally intelligible.

Until quite lately it was customary to divide gases into two classes—"permanent gases" and "condensable gases" or "vapours." Gaseous water or steam was usually described as typical of the latter; oxygen, hydrogen, or nitrogen of the former. Earlier than this, many other gases were included in the permanent list; but Faraday made a serious inroad upon this classification when he liquefied chlorine by cooling and compressing it. Long after this, the gaseous elements of water, and the chief constituents of air, oxygen, hydrogen, and nitrogen, resisted all efforts to condense them; but now they have succumbed to great pressure and extreme cooling.

We thus arrive at a very broad generalisation, viz., that all gases are physically similar to steam, (I mean, of course, "dry steam," *i.e.*, true invisible steam, and not the cloudy matter to which the name of steam is popularly given,) that they are all formed by raising liquids above their boiling-point, just as steam is formed when we boil water and maintain the steam above the boiling-point of the water.

But some liquids boil at temperatures far below that at which others freeze; liquid chlorine boils at a temperature below that of freezing water, and liquid carbonic acid below even that of freezing mercury, and liquid hydrogen far lower still. These are cases of boiling, nevertheless, though it seems a paradox according to the ideas we commonly attach to this word. But such ideas are based on our common experience of the properties of our commonest of liquids, viz., water.

When water boils under the conditions of our ordinary experience, the passage from the liquid to the gaseous state is a sudden leap, with no intermediate state of existence that we are able to perceive; and the conditions upon which water is converted into steam—the liquid into the gas—while both are at the bottom of our atmospheric ocean, are such as to render an intermediate condition rationally, as well as practically, impossible.

We find that the expansive energy by which the steam is enabled to resist atmospheric pressure is conferred upon it by its taking into itself, and utilising for its expansive efforts, a large amount of calorific energy. When any given quantity of water is converted into steam, under ordinary circumstances its bulk *suddenly* becomes above 1,700 times greater—a cubic inch of water forms about a cubic foot of steam, and nearly 1,000 degrees of heat (966·6) disappears *as temperature*. Otherwise stated, we must give to the cubic inch of water at 212° as much heat as would raise it to a temperature of 212 plus 966·6, or 1178·6° if it remained liquid. This is about the temperature of the glowing coals of a common fire; but the steam that has thus taken enough heat to make the water red hot is still at 212°—no *hotter* than the water was while boiling.

This heat, which thus ceases to exhibit itself as *temperature*, is otherwise occupied. Its energy is partly devoted to the work of increasing the bulk of the water to the above-named extent, and partly in conferring on the steam its gaseous speciality—that is, in overcoming liquid cohesion, and substituting for it the opposite property of internal repulsive energy which is characteristic of gases. My reasons for thus defining and separating these two functions of the so-called "latent" heat will be seen in the next paper, when we come to the philosophy of the interesting researches of Dr. Andrews.

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GERMS OF DISEASE AND DEATH.

By Dr. Andrew Wilson, F.R.S.E.

Part II.

TURNING now to the *Charbon* or *Splenic Fever*, we witness another veritable triumph of Pasteur's industry and research. In 1850, certain observers noted the interesting fact that minute, rod-like bodies, which appeared to be lower forms of plant life, existed in the blood of animals affected with this disease. The "rods," it was observed, originated from particles which might, with perfect accuracy, be called "Germs." And as we watch the "rods" in turn, we see that, sooner or later, microscopic specks appear in their substance; these grow to form regular bead-like rows within the "rods;" and when finally the "rods" themselves break up and fall to pieces, these beads are liberated as the "germs," which in time will grow into new rods. Thus countless myriads of rods and germs grow and are reproduced within the body of the animal suffering from *splenic fever*. The fever, in a word, is the result of the growth and development within the living soil, of these rod-like plants. But exact demonstration of the truth of the latter statement can be had.

If we grow and cultivate in a proper fluid—such as the aqueous humour of the eye of an ox—the "rods," we may inoculate with our "rods" the body of a healthy animal. We may *sow* in that animal's body the germs of splenic fever. Thus a drop of a solution containing the "rods" sown within the body of a guinea-pig, produces splenic fever in that animal. And more wonderful still, it has been shown that the dried blood taken from an animal affected with this fever will reproduce the fever, even after an interval of four years, if the dried particles of blood with their "rods" be introduced into the body of a healthy animal.

Pasteur, armed with knowledge of the kind just detailed, set himself to ascertain the "reason why" splenic fever should suddenly appear in districts which knew it not, and wherein only healthy animals lived. Obviously, if the germ theory were true, such sudden and apparently isolated outbreaks must be capable of being explained on this hypothesis. The idea of the "spontaneous," or *de novo*, or *ex nihilo* origin of the disease would, if supported by facts, prove fatal to the "germ theory." Here, then, was a typical case for scientific investigation. Let us see how the genius of Pasteur overcame the difficulties of the situation.

The localities in which splenic fever seemed to burst out suddenly and without warning were, as Pasteur learned, former seats of the disease. But the interval between the visitation was to be measured by years. How, then, could the new outbreak be accounted for? It seemed, in truth, as if the one outbreak had little or nothing to do with the other. The infected animals which had died, or had been killed, whilst suffering from the fever, were duly buried, and that very deeply, in the soil. Such a method of interment would seem to obviate all risk of infection. But the possibilities of nature are illimitable, and no man knew this better than Pasteur. If the poison had been buried in the soil, why should it not be there still? And, further, why should it not be conveyed upwards to infect the fresh flocks that fed on the graves of their predecessors? With a gift of scientific divination, Pasteur sought in the earthworm, the type of the "middle-man" betwixt the living and the dead. He now examines the bodies of the worms which live in the soil wherein the bodies of the animals infested with splenic fever, years before, were entombed. By experimental means, he solves his problem. He makes a preparation of the contents of the digestive system of the worms. This he administers in the food of healthy animals, entirely removed from the pastures. And once again a scientific principle dawns in view. The rabbits and guinea-pigs which devoured the matter obtained from the worms at once developed splenic fever, whilst in their blood the rods were seen developing in full force. Once again Pasteur had sown the fever, and had argued thus from the result, backwards to the cause. It has also been proved that even grain may convey the subtle "rods" to healthy animals, and may in this way engender splenic fever. Following close upon the heels of the discovery of the germ-origin of this fatal malady comes the gratifying announcement that, as small-pox is modified by vaccination, so splenic fever may be modified by an analogous process. Pasteur has proved that we can inoculate sheep and cattle with a mild form of the fever which protects the animal from a recurrence of the disease; and this protective influence, as we write, is being practically utilised by the breeders of France.

Such is a brief recital of a new step towards a perfect knowledge of the nature of the diseases which decimate, not merely animal life, but human existence as well. It may not be inappropriate if, by way of close, we remind our readers of two very noteworthy points in connection with this all-important topic, bearing, as it does, in the most intimate manner upon the physical welfare of man.

The first of the points to which we refer concerns the apparently trivial origin of an all-important subject. It was in the city of Florence, some two hundred or more years ago, that a certain physician, Francesco Redi by name, demonstrated to the Florentine wiseacres that the maggots in meat do not arise from the dead meat by "spontaneous generation," but were produced from the eggs of the flesh-flies. This result he achieved by covering over the meat with gauze, so that whilst the meat-decay proceeded, there was likewise a convincing absence of maggots. Childishly simple as was Redi's experiment, it laid the basis and method of all succeeding research; for from his day down to ours the progress of the "germ theory"—or of that doctrine which holds that all life, however mysteriously generated, must spring from pre-existing life—has been uniform and triumphant.

But the second point to which attention is worthy of being directed, exists in the statement that the practical and actual benefits which have flowed to human health, and which are likely to flow in the future as well—the saving of life by the prevention and extermination of disease—arise from a simple study in natural history. So-called "practical" minds are often given to loudly express their disapproval of any science which deals with what, to them, seem mere abstractions. Doubtless, to such minds the study of the development of the "rods" of splenic fever under a watch-glass must seem a piece of scientific *dilettantism;* just as information respecting the solar system may seem despicable enough, because its results cannot be measured by a profitable currency, or, in plain language, because it "doesn't seem to pay." The best answer to such foolishness is found in a recital of the results to human and animal life to which natural history study seems likely to lead. Just as two hundred years ago, in Florence, Redi began the good work by a simple study in zoology, so to-day we are reaping the reward of the earnest work of the botanists and zoologists who toil and labour to spread abroad their saving knowledge.

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BRAIN TROUBLES.

Impaired Memory — (*continued*).

THE following case is one of those in which sudden failure of memory implied serious cerebral mischief. "An eminent provincial surgeon, of large and anxious practice, was seized with a sudden failure of memory. He forgot all his appointments, and to such a degree was the faculty of retention impaired" (so far as the names and cases of patients were concerned) "that he was obliged to make memoranda of every trifling and minute circumstance which it was important for him to remember, and to these he was constantly referring in order to refresh his memory. This attack was preceded by headache, of which he had complained for nearly a fortnight." Up to the period of the case being brought to the attention of Dr. Forbes Winslow, who treated it, no suspicion had been entertained of the existence of any prior state of cerebral ill-health, sufficient to account for the patient's sudden loss of mental power. Dr. Winslow ascertained, however, that "about eight weeks, or nearly three months previously" (not a very clear way of putting the matter, by the way), the patient had been seized, whilst in the act of applying a stethoscope to the chest of a patient, with severe epileptic vertigo. For about a second he lost consciousness. This had been succeeded by an attack of distressing sick headache. "Three days subsequently he had a second paroxysm of giddiness, and nearly fell out of the carriage in which he was sitting at the time. His spirits subsequently became much depressed, but in a few days he again rallied, flattering himself that he had quite recovered. He made no mention of these attacks to any member of his family, and carefully avoided all conversation on the subject of his health with his medical brethren." "When I saw this gentleman," says Dr. Winslow, "the only appreciable mental symptom was inability to retain in his mind, for many consecutive minutes, any recent impressions. His pulse was feeble, face pallid, and general health shattered. His spirits were, however, at times buoyant, and the prognosis which he formed of his own case was favourable." The result showed that he was a false prophet. Two weeks later he had an epileptic fit. He then became rapidly worse, and ten months after he died "in a deplorable state of mental imbecility."

But against such a case as this, which was obviously exceptional, may be set the following case, in which, under similar conditions, so far as appearances were concerned, a complete cure was effected:—A barrister complained to Dr. Winslow of occasional attacks of enfeebled memory. "He attributed this mental impairment," says Dr. Winslow, "to the fact of his having been engaged as counsel the previous year in several anxious and severely-contested election cases. I advised an entire cessation from all professional work, but had great difficulty in persuading him to recognise the necessity for a complete abstinence from mental occupation. He promised a guarded acquiescence in my strict injunctions, but finding himself relieved after an interval of a few weeks, he returned, in opposition to my solicitations, to his chambers, and recommenced active practice. As I predicted," proceeds Dr. Winslow, "he soon broke down, and I was once more conferred with. He then acknowledged it to be a matter of vital necessity that he should give his mind prolonged rest, and agreed unreservedly to do so. I kept him for a period of *two years* from all anxious and severe mental occupation, and by that time his powers of mind had rallied to a surprising extent; in fact, they became, according to his own impression, more vigorous than they were prior to his attack of illness. For many years this patient has continued steadily at work, never having had a return of loss of memory. I should premise that I exacted from him a promise that he would read no briefs after dinner. He has rigidly adhered to this understanding, but being an early riser and a man of remarkable quickness of apprehension, he is enabled to master a large amount of work before breakfast. I also made it a *sine quâ non* that he should go abroad every year for a period of two months, thus ensuring for him a complete diversion and relaxation of mind from all injurious pressure. He has scrupulously complied with my instructions, and the result is an entire freedom from all symptoms of mental impairment and cerebral disorder." A case such as this is full of encouragement, because here it would seem that at the outset overwork had seriously injured the brain, yet attention to a few simple rules resulted in a complete cure.

Apart from actual injury to the substance of the brain, transient loss of memory seems to be usually caused by a deficient supply of blood to the brain, whether through loss of blood generally, or owing to defective circulation. This is illustrated by the following case:—A lady had been reduced to a state of such extreme prostration by hæmorrhage, that for nearly a week she seemed simply lingering between life and death. After this she remained for a long time in a state of extreme mental depression and vital prostration. When she was able to articulate, her husband was astonished to find that her memory was paralysed. "She had forgotten where she lived, who her husband was, how long she had been ill, the names of her children, and, in fact, her own name was obliterated from her recollection. She was unable to call anything by its right name. In attempting to do so she made the most singular mistakes. She had been in the habit, before her illness, of speaking in French, her husband being a Frenchman; but while in the state of mind described, she seemed to have lost all recollection of the French language. When her husband spoke to her in French, she did not seem to understand in the least what he was saying, though she could at this time speak English without difficulty. Seven or eight weeks elapsed before her memory began to improve, and months passed before her mind regained its original strength."

Intense cold seems to have the power of paralysing the memory. During the retreat from Moscow, many of Bonaparte's officers and men found their memories greatly enfeebled. Bonaparte himself was affected, especially as to dates and names. "For a time he was constantly confusing one person with another, and making odd mistakes in dates." In his case the affection of the memory lasted only a few days;* but one of Bonaparte's *aides-de-camp* lost his memory for several years.

Instances such as these enable us to understand the true meaning of those comparatively slight attacks of failure of memory which most of us experience from time to time. In the first place, we do not find much evidence enabling us to assign to one or other of the two classes of memory-failings above indicated a greater or less degree of importance, whether such failings occur in a marked or slight

* During this time Bonaparte's mind seems to have been affected. "He merely made some gestures of melancholy resignation on every occasion when," during the battle of Semenowska, the *aides-de-camp* sent by Ney "informed him of the death of his best generals. He rose several times to take a few turns, but immediately sat down again. Everyone looked at the Emperor with astonishment. Hitherto, during these great shocks, he had displayed an active coolness; but here only a dead calm, a mild and sluggish inactivity." Count Segur, referring to Napoleon's state at this time, says: "The Russian autumn had triumphed over him."

degree only. Inability to commit new matter to the memory with customary facility seems as likely to be a sign of mischief as inability to recollect matters forming (ordinarily) a part of our stock of familiarly known facts. Again, it is clear we need not fear that mind is necessarily going astray because for a time the memory fails in slight degree. We see that very serious failures of the power of memory may occur where the brain has suffered no irreparable mischief. But since we see that much overwork will cause serious temporary mischief of this particular kind, we learn that where a slight lapse of memory is noticed, the indication may be taken as a sign that rest is needed. But there are, as we have seen, other ways in which this special power may come to be affected; so that if the memory should show signs of failure where we have no reason to believe that overwork has caused the mischief, we may infer that some one or other of the causes which, as we have seen, may affect the memory seriously have operated injuriously in slight degree. Nor in general need we be in much doubt as to the true nature of the cause, simply because we cannot fail (usually) to recognise in the circumstances preceding the attack the origin of the mischief. Thus, although a serious failure of the memory considered apart from the circumstances preceding it might leave the physician in doubt whether depletion or plethora (to mention two possible causes) had produced the mischief, yet the physician, apart even from an examination of the patient's condition, could learn at once from him whether either of these two opposite conditions had existed before the attack. In like manner, any person whose memory suddenly seemed weakened could, as his own physician, ascertain (unless, indeed, his memory failed to remind him how he had passed the hours or days preceding the attack) whether the mischief resulted from deficiency or excess in the amount of food or stimulants he had previously taken, whether the proper remedy would be, on the one hand, some such medicine as a glass of wine and a chop, or, on the other hand, a diminution during two or three days of the amount of food consumed or the avoidance of some of the more stimulating articles of diet. Here, however, we are considering rather those mental troubles which are produced by mental work, whether relating to subjects of great difficulty or carried on too long. We would notice also that in dealing with other indications of mental mischief we need not be careful to show how the more serious cases of each kind suggest the significance of the slighter and far commoner mental troubles which form our real subject of inquiry; for this reason, simply that what we have here said about failure or loss of memory applies equally to other signs of temporary mischief.

MAN A FRUIT-EATER.*

MAN'S nearest of kin among the animals is the ape. This is shown not only by those outward features which all can recognise, but more clearly and more certainly by the structure of the nervous system. The animal in which this system resembles most closely the nervous system in man is the ape, and of all apes, that which comes nearest to man in this respect is the orang. The brain convolutions, which in rodents (gnawing quadrupeds—rats, squirrels, &c.) and edentates (toothless quadrupeds—ant-eaters, ground-hogs, &c.), are very simple, in the flesh-eating animals are more developed, and in the apes, especially the orangs, they are developed still more fully. "We are authorised in concluding," says Professor Mivart, that "the difference between the brain of the orang and that of man, as far as yet ascertained, is a difference of absolute mass; it is a difference of degree, and not of kind."

Starting from this relationship, Miss Kingsford, in the book before us, proceeds to indicate the bearing of man's kinship to apes on the vexed question of man's proper or natural food. Carefully studying the entire digestive apparatus of animals and men, and especially comparing this apparatus in men and apes, she is led to the conclusion that man approaches nearest in this respect to those animals which are eaters of fruits and herbs. "If," she says, "we have consecrated to this sketch of comparative anatomy and physiology a paragraph which may seem a little wearisome in detail, it is because it appears necessary to combat certain erroneous impressions affecting the structure of man, which obtain credence, not only in the vulgar world, but even among otherwise instructed persons. How many times, for instance, have we not heard people speak with all the authority of conviction about the 'canine teeth' and 'simple stomach' of man as certain evidence of his natural adaptation for a flesh diet? At least we have demonstrated one fact, that if such arguments are valid, they apply with even greater force to the anthropoid apes—whose 'canine' teeth are much longer and more powerful than those of man—and the scientists must make haste, therefore, to announce a rectification of their present division of the animal kingdom in order to class with the carnivora (flesh-eaters) and their proximate species all those animals which now make up the order primates (men and apes). And yet, with the solitary exception of man, there is not one of these last which does not in a natural condition refuse to feed on flesh!" Pouchet says that all the details of man's digestive apparatus, as well as his dentition, are proofs of his frugivorous (fruit-eating) origin. Professor Owen agrees that the close analogy between apes and man demonstrate his frugivorous nature. So Cuvier, Linnæus, Lawrence, Bell, Gassendi, Flourens, and a host of other authorities.

Yet another belief is as common as it is erroneous, viz., that "flesh food contains the elements of physical force, and that to be strong, robust, and endowed with muscular energy it is necessary to partake largely of animal food." Yet no flesh-fed animal rivals in strength the herb-eating rhinoceros, in endurance the horse, the mule or the camel. A gorilla feeding on fruits and nuts is more than a match for the far heavier lion. "The buffalo, the bison, the hippopotamus, the bull, the zebra, the stag, are types of physical power and vast bulk, or of splendid development of limb. Only in ferocity are flesh-eating animals superior (?) to those who find their food in fruits and herbs."

As regards man himself, the idea that the flesh-eaters are the most powerful, is erroneous, as is the cognate idea that to acquire strength, a man should eat daily large quantities of flesh meat. "In the palmy days of Greece and Rome, before intemperance and licentious living had robbed those kingdoms of their glory and greatness, their sons, who were not only soldiers but heroes, subsisted on simple vegetable food, rye meal, fruits, and milk. The daily rations of the Roman soldier were one pound of barley, three ounces of oil, and a pint of thin wine. It was no regimen of flesh that inspired the magnificent courage of the Spartan patriots who defended the defiles of Thermopylæ, or that filled with indomitable valour and enthusiasm the conquerors of Salamis and Marathon." Among the nations of

* "The Perfect Way in Diet; a Treatise advocating a return to the natural and ancient fruit of our race." By Anna Kingsford, Doctor of Medicine of the Faculty of Paris. (London: Kegan Paul, Trench, & Co.)

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to-day, also, we find the fruit-eaters and herb-eaters as enduring, to say the least, as the flesh eaters,—and healthier.

Are we then to infer with our author that a diet of fruit and seeds, preferably uncooked, is the best for the human race? Or, if we infer this, may we conclude that all would do well to adopt such a diet? It might be unsafe to accept the latter inference, for habit and custom count for something in such matters. But we may very safely adopt the opinion, now generally prevalent among experienced physicians, that fruit and seed, herbs and vegetables, should form a larger proportion of our food than they do. Precisely as many who do not accept, in its entirety, the views of Dr. Richardson about alcoholic stimulants, yet hold that these stimulants, if taken at all, should be taken in much smaller quantity than is customary, so, many who would not agree with Miss Kingsford, that animal food should be entirely displaced (which is Dr. Richardson's opinion also), yet see that it would be well if flesh meat were taken in much less quantity than at present.

How much custom has to do with the use and effects of flesh meat is shown by cases such as Miss Kingsford mentions, in which persons unaccustomed to flesh meat have been actually intoxicated by its use. Dr. Dundas Thompson tells us of some Indians accustomed to vegetable food, who, dining luxuriously on meat, showed an hour or two later, by their jabbering and gesticulations, that the same effect had been produced upon them as if they had taken some intoxicating spirit or drug.

Apart from the special doctrine which Miss Kingsford advocates, her little treatise is well worth studying for its clear and correct account of the various forms of food used by man. There is much matter for reflection, also, in what she says about slaughter-houses, fox-hunting, pigeon-shooting, and the cruelties of the fur trade.

The Spectroscopic Analysis of Light.—We may illustrate this process by a similar one, which we might imagine mankind to perform. Suppose Nature should loan us an immense collection of many millions of gold pieces, out of which we were to select those which would serve us for money and return her the remainder. The English rummage through the pile, and pick out all the pieces which are the proper weight for sovereigns and half-sovereigns; the French pick out those which will make 5, 10, 20, or 50-franc pieces; the Americans the 1, 5, 10, and 20-dollar pieces, and so on. After all the suitable pieces are thus selected, let the remaining mass be spread out on the ground according to the respective weights of the pieces, the smallest pieces being placed in a row, the next in weight in an adjoining row, and so on. We shall then find a number of rows missing—one which the French have taken out for 5-franc pieces; close to it another which the Americans have taken for dollars; afterwards a row which have gone for half-sovereigns, and so on. By thus arranging the pieces, one would be able to tell what nations had culled over the pile, if he only knew of what weight each one made its coins. The gaps in the places where the sovereigns and half-sovereigns belonged would indicate the English, that in the dollars and eagles the Americans, and so on. If, now, we reflect how utterly hopeless it would appear, from the mere examination of the miscellaneous pile of pieces which had been left to ascertain what people had been selecting coins from it, and how easy the problem would appear when once some genius should make the proposed arrangement of the pieces in rows, we shall see in what the fundamental idea of spectrum analysis consists. The formation of the spectrum is the separation and arrangement of the light which comes from an object on the same system by which we have supposed the gold pieces to be arranged. The gaps we see in the spectrum tell the tale of the atmosphere through which the light has passed, as in the case of the coins they would tell what nations had sorted over the pile.—*Newcomb's Popular Astronomy.*

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A MILD NOVEMBER.

The weather of the month that has just elapsed has been so unusually mild, that a few statistics respecting mild Novembers in general, and the past one in particular, may not be without interest.

It appears that in London the average temperature of the first twenty-five days of the past month has been as much as 7° above the mean of twenty years' observations; and, if it is fair to compare the London temperatures with those of Greenwich, the past November has been decidedly the warmest experienced during the present century. Relatively warm Novembers were observed in the following years:—1806, 1817, 1818, 1821, 1822, 1824, 1845, 1846, 1847, 1850, 1852, 1857, 1863, 1865, 1866, and 1877. The warmest of these was 1852, when the mean temperature in London was 48·9°, or rather more than a degree lower than that of the month that has just passed away. The maximum readings observed during the month under review have been exceptionally high, and those of the 5th and 10th, when the thermometer in the shade rose to 64°, have only been exceeded once during the present century. This was on Nov. 8, 1847, the reading then being as high as 67°.

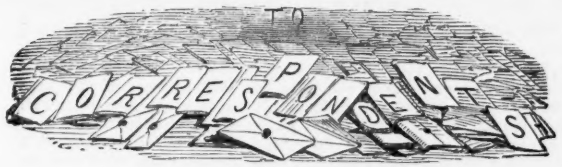
On looking over the meteorological returns from several English stations, we find that, while the thermometer has been unusually high throughout, there have been three periods of especially warm weather. The first of these occurred on the 5th, the second about the 13th or 14th, and the third about the 20th or 21st. In the subjoined table, the temperature on each of these occasions has been compared with the mean for the corresponding day of thirteen years:—

Stations.	5th.		13th or 14th.		20th or 21st.	
	Temp.	Difference from mean.	Temp.	Difference from mean.	Temp.	Difference from mean.
	deg.	deg.	deg.	deg.	deg.	deg.
North Shields	51·0	+ 6·2	55·0	+12·2	50·0	+ 8·5
York	51·5	+ 6·7	55·0	+12·0	50·0	+ 8·4
Yarmouth	52·5	+ 6·5	52·5	+ 8·9	50·0	+ 7·6
Cambridge	58·0	+12·8	54·5	+11·3	52·5	+10·5
Nottingham	56·0	+10·5	57·0	+13·7	52·5	+10·7
Leicester	54·6	+ 9·2	55·3	+12·0	50·1	+ 9·3
Birmingham	56·1	+10·6	56·6	+13·2	50·0	+ 7·4
Hereford	56·6	+ 9·8	57·9	+13·6	51·0	+ 8·1
Oxford	57·0	+10·6	54·5	+10·6	54·5	+12·3
London	59·5	+19·7	56·0	+11·4	54·5	+11·6
Marlborough	54·2	+ 7·5	55·5	+11·2	49·6	+ 6·8
Dover	54·5	+ 6·9	52·0	+ 6·8	53·0	+ 9·7
Hastings	54·5	+ 6·9	52·7	+ 7·5	52·5	+ 9·2
Silloth (Carlisle)	49·7	+ 4·7	54·1	+10·8	49·7	+ 7·1
Barrow-in-Furness	50·5	+ 5·2	51·5	+ 8·3	50·0	+ 7·2
Manchester	50·2	+ 5·0	55·0	+11·9	47·6	+ 5·7
Liverpool	53·0	+ 6·8	56·5	+12·3	51·5	+ 8·7
Holyhead	54·5	+ 7·5	53·0	+ 7·5	52·5	+ 8·3
Pembroke	54·0	+ 6·2	54·0	+ 7·7	53·0	+ 7·3
Plymouth	56·8	+ 7·2	54·8	+ 7·5	53·8	+ 7·7

It will be seen that on the 5th, the average temperature was from 5° to 7° above the mean in the north of England, and also on the south coast, but that in the Midland counties it was between 9° and 11° above, while at Cambridge and in London the excess was nearly 13°. On the 13th or 14th—for in some places the greatest heat was on the former date, and in others it occurred on the latter—the excess was between 7° and 8° on the west and south-west coasts, but between 11° and 13° at most of the inland stations, while at Nottingham and Hereford it amounted to more than 13½°. On the 20th and 21st the weather was not quite so warm, but even then the temperature was more than 10° above the mean in many parts of central England, and as much as 12° in excess at Oxford.

On examination, it appears that a warm November is usually associated with great storms, and frequently accompanied by disturbance of an electrical nature in the shape of thunderstorms and displays of aurora borealis. The month under review has certainly been distinguished for these phenomena, although their influence has been chiefly confined to the more western and northern parts of the kingdom.

F. J. B.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. He requests that all communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

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All Letters or Queries to the Editor which require attention in the current issue of KNOWLEDGE, *should reach the Publishing Office not later than the Saturday preceding the day of publication.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

Our Correspondence Columns.

THE INVISIBILITY OF LIGHT—INCLINATION OF THE EARTH'S AXIS—THE ZOETROPE.

[49]—Without entering—at all events for the present—into the discussion of the question "Is the Sun hot?" I should like to suggest to "Tyro" (letter 6, p. 35) a simple experiment which will give him ocular demonstration that light is invisible. Let your correspondent, then, make a pasteboard tube, ten or twelve inches long, and three inches in diameter. Close the bottom with a disc of card, and line the whole with black velvet. This done, let him cut two holes, say half an inch in diameter, opposite to each other, two-thirds of the way towards the closed end of the tube; and between these a third hole. If he will hold this simple piece of apparatus so that the sun shall shine across the tube, *i.e.*, so that sunlight shall enter in at one of the side holes and pass out at the other, and will look into the tube through its open end, he will see —nothing; the interior being totally dark. Now, let him introduce a strip of writing paper through the hole between the two others (which should be at the lower side of the tube), and push this paper up until it enters the beam of sunlight. Instantly the interior of the tube will become illuminated, because the previously invisible light will be reflected from the paper, and so become perceptible. "Tyro" has presumably noticed that a beam of sunlight entering a darkened room through a hole or chink in the shutter is traceable as it crosses the apartment. This, however, arises from the reflection of the light by the particles of dust which fill the atmosphere of the apartment. Were it practicable to eliminate these by burning, or otherwise, the path of the ray would be quite invisible, and the round spot of light on the floor or opposite wall, would be the only indication we should receive of the entry of sunlight into the darkened chamber at all.

I do not know whether the "Tyro" of letter 9 (p. 36) is the same "Tyro" as he to whom I have just been essaying a reply. At any rate, I will suggest another experiment as a means of clearing up this second difficulty. It is this. Let your querist obtain a lamp, an apple, and a knitting-needle. Furnished with these, he must thrust the knitting-needle diametrically through the apple, and place the lamp in the middle of the table. The lamp will stand for the sun, the apple for the earth, and the knitting-needle for its axis. Now, he must incline the needle 23°, and we will suppose that, in doing so, he causes the top of it to point to the north wall of his room. Then he must carefully preserve the direction of the needle constant in this position, and, doing so, carry it round the lamp. An instant's reflection will show him that, should he start from the north side of the lamp, the upper or northern end of his needle (and obviously the northern half of his apple-earth) will be inclined from the lamp; and that when he brings it round to the south side of the lamp, the top of the axis, still pointing to the north wall of the room, must be inclined towards it. The end of "Tyro's" query is not quite so intelligible as might be desired; but he seems to conceive in some occult way that the earth's rotation must affect the position of her axis. If, while studiously keeping his knitting-needle axis parallel to itself during its revolutions round the lamp, he twists it so as to make the apple rotate on it, he will at once see how the two movements may be independent of each other.

As "Moonstruck" (query 4, p. 38) has a question on a cognate subject, I may say that perpetual spring, rather than perpetual summer, would reign at the poles of the earth, were its axis perpendicular to the plane of the ecliptic. Summer would, of course, be continuous at the Equator, where the sun would be always vertically overhead.

If "Zulu" (query 10, p. 38) will reflect, *imprimis*, how much what we call seeing is a matter of inference, and, in the next place, remember that the image of any object is retained by the retina for something like 0·1 second after such object has disappeared, he will get some idea of the way in which the images in the Zoetrope are caused, as it were, to shade into each other, the mind unconsciously supplying the intermediate steps. The real images, in the case of an actually moving object, must, so to speak, overlap in a way which must render it impossible to predicate definitely that any one given instantaneous attitude of the body in motion has been actually observed.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

THE MISSING LINK.

[50]—Dr. Andrew Wilson does good service in making known to your readers the erroneousness of the widespread notion that man is descended from monkey. Concerning the question to which he makes excellent reply, I think the following remarks in Professor Huxley's Preface to Hœckel's "Freedom of Science" (p. xiii.) will be serviceable.

"All the real knowledge which we possess of the fossil remains of man goes no further back than the quaternary epoch, and none of these remains present us with more marked pithecoid* characters than such as are to be found among the existing races of mankind. But then the equine quadrupeds of the quaternary period do not differ from existing *Equidæ* in any more important respect than these last differ. Yet it is a well-established fact that in the course of the tertiary period, the equine quadrupeds have undergone a series of changes exactly such as the doctrine of evolution requires. Hence sound analogical reasoning justifies the expectation that when we obtain the remains of pliocene, miocene, and eocene *anthropidæ*, they will present us with the like series of gradations."
—EDWARD CLODD.

THE 1-INCH ORDNANCE MAPS.

[51]—In the first numbers of KNOWLEDGE, attention has been called to the fact that the 1-inch to the mile Ordnance maps are not trustworthy. A very good case in point has come to my knowledge. From Handcross, in Sussex, three roads run to Brighton, one through Crabtree and Henfield, one through Cuckfield, and the other through Hicksted and Bolney. The one through Crabtree leaves the other roads about a mile south of Handcross Gate, and is shown in the right place on the map. The one through Cuckfield leaves the one through Bolney about a furlong lower down; but on the map it is a good mile and a quarter, and, consequently, for about three miles run is shown entirely in the wrong place.—I am, &c.,
G. W. BUCKWELL.

PALIZSCH AND HALLEY'S COMET.

[52]—Allow me to point out that, in an article on Comets in the first number of KNOWLEDGE (p. 10), you have inadvertently adopted an oft-repeated error, that when Palizsch re-discovered Halley's comet on Christmas Day, 1758, he found it "without telescopic aid." A complete account of his discovery, in his own words, will be found in the "Berliner Jahrbuch" for 1828, by which it appears that it was made with a telescope of 8 ft. focal length, and was the result of a search for the comet in the part of the sky where he expected it to appear. With this he noticed, about six o'clock on the evening in question, a nebulous-looking object, between ε and δ Piscium, which he had not seen there before; and subsequent observations, on Dec. 26 and 27, proved that it was indeed a comet. Thus did Palizsch (who, though certainly a farmer, was not a peasant, for he was a man of education, and an amateur in botany and other sciences, besides astronomy) first observe the predicted return of a comet nearly a month before anyone else; Messier being the next, and observing it at Paris, with a 4½ ft. Newtonian, on Jan. 21, 1759. I presume the mistake that Palizsch found it casually, and without telescopic aid, was founded on a misunderstanding of a note in Herschel's "Outlines," which certainly conveys that impression, but does not actually state it, so that it is difficult to be sure whether Sir John really thought so. But at any rate, it has been repeated in many books on astronomy, and Mädler thought it

* Ape-like.

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necessary to contradict it in his "Geschichte der Himmelskunde" (vol. II., p. 460). Palizsch was less fortunate in 1780, when he thought he had discovered another comet in Cancer, which proved, however, to be a now well-known nebula. He died at Lungraa, near Dresden, on Feb. 22, 1788, in the 65th year of his age; his memorable discovery on Christmas Day, 1758, was made at Prohlis, between Dresden and Pirna.—Yours, &c.,

Blackheath, *Nov.* 14. W. T. Lynn.

DO COMETS OBEY GRAVITY?

[53]—As I am probably the victim of ill-written text-books, such as you allude to in your introduction to the correspondence columns, perhaps you will kindly permit me to be set right in regard to a little matter which has occasionally troubled me, and which is again suggested by the article on comets.

It is stated in that article that comets obey the law of gravitation; and also that the matter of which they (or at least their tails) are composed is of inconceivable tenuity.

What puzzles me, then, is how these flimsy concerns can possibly be obeying the laws of gravitation, which I understand to mean that bodies attract each other in proportion to their mass. How is the sun's attraction, which fixes the *massive planets* to their present paths, to be reconciled with the fact that these *airy bodies* wander round orbits so gigantic?

If you cannot afford space for my difficulty, a reference to what you consider a reliable work will greatly oblige, yours, &c.,

Comet.

THE CRIMSON-CIRCLED STAR.

[54]—Will you kindly inform me to what star Tennyson refers in "In Memoriam," LXXXVIII., verse 12—

"And last, returning from afar,
Before the crimson-circled star
Had fallen into her father's grave."

The use of the feminine possessive pronoun would naturally suggest Venus. But why "crimson-circled"? Would this be effect of refraction on the horizon? If so, though only a dilettante astronomer, I do not remember having observed it.

I wish every success to your new Magazine, whose motives and virtues I diligently proclaim everywhere.

Quite apart from punning, I think you have taken as your motto,

"Sublimi feriam *sidera* vertice."

Yours faithfully, M.R.C.S.

[I have always supposed crimson-circled here to mean surrounded by the crimson sunset glory. Is it not LXXXIX.?—Ed.]

TABLES OF MERIDIANAL PARTS.—THE FLAT EARTH.

[55]—Can you tell me how it is that the Table of Meridianal Parts in Riddle's Book of Tables differs so much in some parts from the corresponding table in Chambers' and Norie's books? The fact is the more strange, because the formula which Riddle gives for calculating that same table yields results identical with those tabulated in the two latter works. Which is likely to be the more trustworthy, Chambers' book or that of Riddle?

Have not you, and men of science in general, a right to ask your impassioned friend and determined enemy "Parallax" to prove that he has some clearly-defined, or, at all events, some intelligible theory of the motions of the heavenly bodies, and some conception of what that theory involves, by (1) constructing a set of tables which would enable us to find our way about on the earth; or (2) by forecasting for us such events as eclipses, planetary transits, &c.; or (3) by showing how it comes to pass that if the upholders of the Newtonian theory be the fools, or impostors, or empirics which he asserts them to be, their forecasts are so invariably justified by results?

And if he refused, or were unable to give an account of himself in some such way, to forbid him, on pain of a writ "*De lunatico inquirendo*," to open his mouth, or write, or ever send telegrams on this subject as long as he lived, to any living man, saving only Mr. Newton Crosland.—Your obedient servant (and admirer and well-wisher), Winter.

P.S.—It would be interesting to discover what would be the result of the meeting and intermingling of chaos with chaos (in the way hinted at above)—whether it would be order or annihilation.

[It was a favourite idea of the late Professor De Morgan's to set paradoxer against paradoxer. It is singular that they only agree in attacking the theories which men of science agree in accepting. They never agree among themselves. Each may have a follower or two, or even ten or twenty; but they do not follow each other.—Ed.]

PYRAMID MEASURES.

[56]—With reference to your remark about the coincidences, I may remark that my mathematical knowledge does not enable me to prove that it is possible to produce the same coincidences by the use of any other values of the diameters and distances of the three bodies, and of the scale of reduction, than those I have given; if, however, it can be proved to be possible, then I admit my conclusions will not be entitled to the consideration which at present I claim for them. And further, if the next transit of Venus be observed, as it ought to be, and the resulting value of the sun's distance proves to be identical, or very nearly so, with the value I have derived from the pyramid measures, will it be quite satisfactory to a mind of average intelligence to say that the agreement is a mere coincidence? Of course, you may reply that this argument has no present value; nor am I inclined to attach much weight to it, because, looking at the results of past transits, it is scarcely to be expected that the next will finally settle the question of the sun's distance, and yield a result in which all astronomers will concur, and which will be more reliable than the one derived from the pyramid measures. Probably the results of Professor Winnecke's new method of determining the sun's distance from Venus observations will be more accurate than any of the results obtained by other methods.

I think a much greater interest is now being taken in the pyramid than you seem to be aware of. An active correspondence has been going on this week in one of the Manchester papers, in which, however, I have taken no part; and a lecture was delivered there on Wednesday evening. Lectures are also being given in other towns and districts, and the pyramid is apparently fast becoming a household word.

I notice printer's errors in four of my equations which render them unintelligible. I enclose a list of corrections of four of the formulæ in my paper.—Yours, &c., Joseph Baxendell.

Corrections of formulæ in paper on "The Great Pyramid Measures, and the Diameters and Distances of the Sun, Earth, and Moon."

9. for $\frac{se^3}{9ms}$ read $\frac{se^3}{9mS}$

20. „ $\frac{\sigma^3\sqrt[3]{\pi^3}}{e^3 2\sqrt{10^5}}$ „ $\left(\frac{\sigma^3\sqrt[3]{\pi^3}}{e^3 2\sqrt{10^5}}\right)^3$

31. „ $\frac{S\pi}{4\pi}$ „ $\frac{S\pi}{4\eta}$

33. „ $10\sqrt{\frac{Se}{m}}$ „ $10\sqrt{\frac{se}{m}}$

INTELLIGENCE IN ANIMALS.

[57]—Some years ago my father, who was a medical practitioner in Somersetshire, had a valuable horse, which eventually he was obliged to part with, as it was vicious, and not always safe to drive. During the time my father drove it, he had occasion to visit daily for several weeks an old gentleman who had met with a serious accident. His patient lived at the bottom of a steep lane, which branched off at right angles from the main road, at about 3½ miles from the town where my father lived. This horse was always used for visiting this patient, and during the first two or three weeks, when there were dangerous symptoms, was frequently driven down the lane twice a day.

The farmer to whom my father sold this horse lived at a distance of several miles beyond this turning on the same road, and attended regularly the market in the town where my father lived, and necessarily passed this sharp turning both going and returning therefrom. Some three or four years after purchasing this horse, he had occasion to drive into the town to fetch my father to attend his wife. As the case was urgent, he got into the gig, and was driven by the farmer towards the farm where he lived. Suddenly, without the slightest warning, the horse turned down the lane he knew so well, nearly capsizing them.

As soon as they had recovered themselves, the farmer exclaimed that "he had never known the horse do such a thing before all the years he had had it." My father was surprised, and said, "Not when you have driven this way to and from the market?" The farmer replied, "that the horse never even so much as looked at the turning, whilst he had driven it, until now." "Well," said my father, "he must associate me, knowing that I am in this gig, with the many visits he used to pay with me down that lane, when I attended my poor old patient at the bottom, after his accident. I patted his nose before starting, and he knows by my voice that I am behind him. His memory has served him well, and he concluded that I must be going the same journey we performed together so many years ago." My father always considered this fact evidence of reasoning powers in the

horse, and although I incline to the same opinion, I will not comment upon it, but content myself with simply relating this anecdote. A. H.

Nov. 19, 1881.

[58]—A singular instance of *apparent* prescience in a dog occurs in an account given Nov. 21 of a father shot by his son. Here is the evidence of the wife and mother:—

"We heard nothing to disturb us after retiring to bed until about half-past two o'clock next morning. About that time a little dog which belonged to my husband, and was a great favourite, came upstairs, and jumped upon our bed. My husband tried to make the dog go away, but he could not do so, as the little thing seemed so 'fussy.' At last he thought the best thing to do would be to take the dog downstairs, and by shutting the door at the bottom, prevent it from returning. My husband got out of bed, and took the dog in his arms for the purpose of carrying it away. In about half-a-minute, and when he was on the stairs, I heard a loud report, as if a pistol or a revolver was being fired. This was repeated twice, and the deceased then shouted out at the top of his voice, 'I am shot!'"

The peculiarity here is that the coming danger, of which the animal appeared cognisant, could only have been imparted by the footsteps or other movements of *a member of the family*; this, under ordinary circumstances, could have given no such premonitions of danger to the dog. Has any similar case been observed?

BARK.

[59]—In the article on "Intelligence in Animals," in No. III. of KNOWLEDGE, p. 46, the writer speaks of animals possessing the power of practical reasoning, but not abstract. Does not the following anecdote show a power of more than merely practical reasoning? I do not know whether it has been quoted by anyone else in this relation to Darwin's theory.

Two students were in the habit of visiting each other at their respective rooms; each had a dog. On one occasion both dogs were left outside the room while their owners were inside. The dogs began to fight, which ended in their being admitted into the room and kept at a distance from each other. On a subsequent visit one dog was absent, and the other dog was put outside as before. The two students were soon after surprised by hearing what they thought was their two dogs outside fighting. On opening the door the dog walked into the room, which was the end he desired. He had remembered the reason why, on a previous occasion, both he and the other dog had been admitted into the room, and he had acted accordingly.—Yours, &c. FREDERICK G. ABBISS.

REASON IN ANIMALS.

[60]—In support of the view that animals possess a certain amount of reasoning power, I would contribute the following instance, which has not hitherto been published.

During my boyhood my father had the shooting over some property adjoining a deer-park, and we owned at this time a very intelligent setter, which used also to retrieve. One day my father shot and wounded a hare, which made its way through a hole in the park-paling. The dog leaped the paling, caught the hare, and brought it back to the fence in its mouth. It then tried several times to return by leaping the paling, but the weight of the hare prevented it from reaching the top. After resting awhile it bethought itself of the hole through which the hare had come, and, taking the hare to this hole, it pushed it through, then leaped the park paling, and brought the hare to my father.—I am, sir, your obedient servant, R. CLEMENT LUCAS, B.S., F.R.C.S.

Nov. 18, 1881.

ARE WOMEN INFERIOR TO MEN?

[61]—I read with much pleasure your remarks on the question, "Are women inferior to men?" It occurs to me that if we are inferior in brain capacity, the reason may be that sufficient care is not taken to develope the brain. We all know the size of the hand is increased by constant work—at least of a particular kind. And constant use of the other parts of the body usually leads to an altered and probably heavier formation. Now, in a girl's education the brain is but slightly exercised. Music and needlework, which occupy so much of her time, scarce exercise it at all. And even the part of her education which does require brain-work seldom calls it forth vigorously. She has fewer rewards to look forward to if she succeeds, and fewer punishments if she idles. Many idle boys require whipping—and get it. Many idle girls require whipping—and do not get it. Then, just when the boy is about entering on the most active part of his brain-work in a University, the girl is taken from school, and sets out on a new course of *flirting* and *husband-catching*. She is sometimes at this work, and perhaps even married at an age when the boy who idles would be whipped—as she ought to be. Again, in her after-life, she has but rarely much brain-work to do, and the development of the brain is probably not maintained. But I should be surprised to hear that the brain development of George Eliot, or George Sand, for instance, was inferior to that of the average male, and if it was, it would prove that the quality, not the quantity, of brain was the really important point. If girls were as well taught at schools as boys, got as much brain-work to do, and were then sent to universities, and did not begin to look for husbands until they were twenty-two or twenty-three years old, I have no doubt their brains would be much improved. I know my views on whipping will be unpopular, but if the sexes are equal, as I contend, why not treat them alike?—I remain, &c., SUSAN G.

EFFEMINACY OF APPEARANCE.

[62]—Can any of your readers give me a description of the characteristic difference between the physiognomy of the male and female of the human species? You may sometimes see men whose features might be called effeminate; now in what does this peculiarity consist?

The article on the question "Are women inferior to men?" brought this to my mind. PHYSIOGNOMIST.

OPTICAL ILLUSION.

[63]—In regard to the optical illusions, there may be added to the instances adduced in Mr. Foster's article, one of circles.

If, say, a 2-inch hole be cut in a piece of brown paper and an inch periphery left round it, and, again, another 2-inch hole be cut with a three inch periphery, the two holes, although exactly the same size, will appear not to be so.—I am, &c.,

PERCIVAL A. FOTHEGILL, F.R.A.S.

A "LUNAR ILLUSION."

[64]—I have frequently noticed what your correspondent M. calls a "Lunar Illusion" (No. 23, p. 57), but I have always supposed a different reason for it, and I hardly think that M.'s arrow hits the mark.

Let us suppose a lighthouse on our horizon; we know that a straight line from it drawn through the moon would bisect it very differently from a line drawn from the setting sun (below, in fact), though the sun would appear in the same place as the lighthouse, and a line from it would, of course, seem as if it ought to bisect it in the same way. The *enormous comparative distance* of the sun seems to me the true reason; and I have sometimes thought that a rough idea of his distance might be made by taking the angle of M.'s sagitta when the moon is near the zenith, knowing, of course, the distance of our satellite from the earth.—I am, sir, yours, &c.,

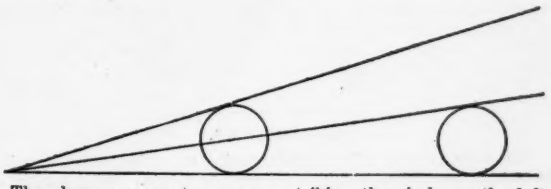
Cleveland Lodge, Sydenham. S. H. W.

TELESCOPES.—OPTICAL ILLUSION.

[65]—Would it be in accordance with your plan to give a popular description of the different kinds of telescopes, with the apparatus, giving a few hints to amateurs in obtaining them, explaining among other things the following:—

The Terrestrial Telescope.
" Astronomical "
" Newtonian "
" Equatorial "
" Huyghenian Eye-Piece.
" Pancreatic " "
" Kitchener's Pancreatic Eye-Piece, &c., &c.
" Different ways of mounting.
" " kind " stands.
" Power that object glasses will bear, &c.

As the circulation of KNOWLEDGE increases, as I am sure it will do, you may be able to spare a portion of space in each number to the above subject.



The above appears to me very striking, the circle on the left looking very much larger, though they are the same size. The illusion vanishes when a card is placed at the top of the circles.

F.H.S.

SOLAR HEAT.

[66]—Referring to Letter 2 (page 15), I am of opinion that whatever conditions apply to this earth apply also to the sun, only in a greater degree. The matter of which the earth (and all the planets and satellites) is composed, once formed part of the sun, which has gradually condensed and left each planet behind in its turn. Geologists tell us that at a period inconceivably remote our globe was in a state of intense heat. This is practical proof that the sun is in a similar state. Referring to Letter 28 (page 58), Mr. Newton Crosland endeavours, by one fell blow, to annihilate the great law of universal gravitation. In promulgating this great law, Newton cleared away heaps of the cumbrous rubbish with which the old schools of astronomy were hampered. Emerson says: "The tendency of all science is to simplify." Mr. Crosland endeavours to complicate.—Yours, &c.,

John Thomson.

IS THE SUN HOT?

[67]—It may interest your readers to know that this subject was discussed in *Design and Work*, Vol. VII., under the question, "Does the Sun Warm the Earth?" The leader of that discussion endeavoured to prove that we receive our heat from the earth, and not from the sun! Under the title of "The Great Primordial Force," it has also received the attention of Henry Raymond Rogers, M.D., of Dunkirk, N.Y., in a paper published in the September number of *Progress of Science*. In this paper, Dr. Rogers propounds a similar opinion to that expressed by your correspondent, "Cogito," in letter 21.

G. E. Bonney.

THE SUN'S HEAT AND THE EARTH'S RADIATION.

[68]—I have read the replies to Anti-Guebre's question (which, like yourself, I have frequently encountered before); but in all of them, including your own, one important factor is omitted—viz., the difference between the obstructive or absorbent power of atmospheric vapour to the rays of heat from different sources. The sun-rays, as several correspondents have stated, pass through our ordinary atmosphere with but little absorption; but this is not the case with "obscure rays," or rays from a less heated and non-luminous source. Hence the earth warmed by the sun does more to warm the air than the sun itself does, because the heat it radiates is absorbed by the air, and also because it warms the air by direct contact and the commingling of the portion of air thus heated with that above, or "convection." It appears to me that even our best treatises give too much credit to this latter action, and too little to the first. The following experiment which I tried many years ago on Mont Blanc, at an elevation of between fourteen and fifteen thousand feet, is instructive. My coat was wetted by falls on the sloppy surface of the glacier below, and at the elevation above-named, I noticed that the coat-tail opposite the sun was thawed, while that in the shade was frozen and stiff. By slowly turning round like a joint of meat before a roasting fire, I alternately thawed and refroze all sides of my coat-tails in about one minute, as nearly as I can remember. The direct rays of the sun were painfully scorching, and skinned my face and ears completely, but in the shade, the thin and highly-dried air permitted a far greater degree of radiation of obscure heat to take place than down below. Hence the freezing. I do not write this to controvert the other explanations given by yourself and correspondents, but merely to supply an additional factor.

Thus, the cooling effect of night radiation is far more effective above than below, seeing that the amount of resistance to the passage of the obscure rays is so greatly diminished there. This is strikingly shown by the sudden freezing of the rills and streamlets, which are such remarkable features of a glacier surface during the summer's day, They all stop as the sun sets, and the sloppy surface of ice is dried, as was the shady side of my wet coat.

W. Mattieu Williams.

LIGHTNING IN NOVEMBER.

[69]—Last night (Nov. 4) at 10.30 p.m., in a perfectly cloudless sky, the flashes of sheet lightning were vivid and incessant. Is not this very unusual at this time of the year? A strong gale was blowing in the Irish Channel at the time.—Yours, &c.,

Liverpool, *Nov.* 23, 1881. E. S.

LOGARITHMS.

[70]—Mr. Grundy asks for information on an important item in connection with Logarithmic work, viz., the tables. Many students give up in disgust this simple process of calculation because they have been unfortunate in their choice of books.

I have been in the habit of using Logarithm Books for many years, for work of every description, and with pleasure give him my experience.

In a long series of logarithmic calculations, the book to use will depend on the number of figures we require in the desired result. For instance, in doing 4-figure work, it would be a loss of labour and time to use a 7-figure table.

The following are the tables I have used with great comfort:—

For 4-figure Work:—

Table of Logs and Anti-Logs, published by Layton, price 1s. (Very useful.) This requires simple interpolation.

Table of Logs and Anti-Logs (Hannyngton), published by Layton, price 5s. A comfortable table, but rather dear.

For 5-figure Work:—

Table of Logs, published by Smith, Elder, & Co., price 1s. 6d. A good book, and well worth the money.

Table of Logs by Gauss. Better than the above, but requires a little more practice. It contains many other useful tables. Can be had of Trübner, price about 1s. 6d.

For 7-figure Work:—

Table of Logs by Bruhns. The best book published; I strongly recommend it. Can be had of Trübner, price about 4s. or less.

Table of Anti-Logs by Filipowski. This is a useful book when many Anti-Logs are required. Published by Bell & Daldy.

Abacus.

THE PRIMARY COLOURS.

[71]—In the little Treatise on Optics, forming part of the course of "Natural Philosophy," published in 1862, by the Commissioners of National Education in Ireland, a statement is put forward with respect to the constitution of the solar spectrum, which differs from that set forth in other similar works upon chromatics.

The correctness of that statement is borne out by what I myself conceive to be the appearance of the character of the colour of violet light, yet I confess I am puzzled to make out how, upon the explanation offered, the colour of the light in question is to be accounted for.

The commissioners, after describing in detail Newton's experiment of breaking up solar light into its seven coloured constituents, continue their statement as follows:—

"In reality, blue, red, and yellow are the only colours present, the rest being combinations of them. For the spectrum consists of a layer of each of these colours, superimposed on the other—the blue, the red, and the yellow appearing distinctly at those points at which they are most vivid in the superimposed and corresponding layers."

"The three colours of which the spectrum is really composed are thus divided among the seven which it contains, calling red rays R, yellow Y, and blue B.

White.	Red.	Orange.	Green.	Blue.	Indigo.	Violet.
20R + 30Y + 50B	8R	7R + 7Y	40Y + 10B	7Y + 12B	12B	16B + 5R."

Thus far the commissioners.

As I have said, the impression produced on my eye bears out distinctly the statement as to the occurrence of *red* light in the violet, exhibited by a really pure prism of dense flint glass. Yet if the spectrum consists simply of the layers of the three colours in question superimposed, it is difficult to conceive what appearance each of those spectra would present, could we manage to obtain it isolated. In what form, for instance, would the red spectrum present itself? From the above table we learn that no red exists in the yellow, green, blue, or indigo, while a considerable amount of red is met with again in the violet. Would the red spectrum exhibit a wide, blank interval, extending from the yellowish end of the orange up to the violet end of the blue?

An explanation of this matter, "plainly worded, exactly described," will doubtless be an easy task for you, and will probably prove a boon to others besides,

Yours, &c.,

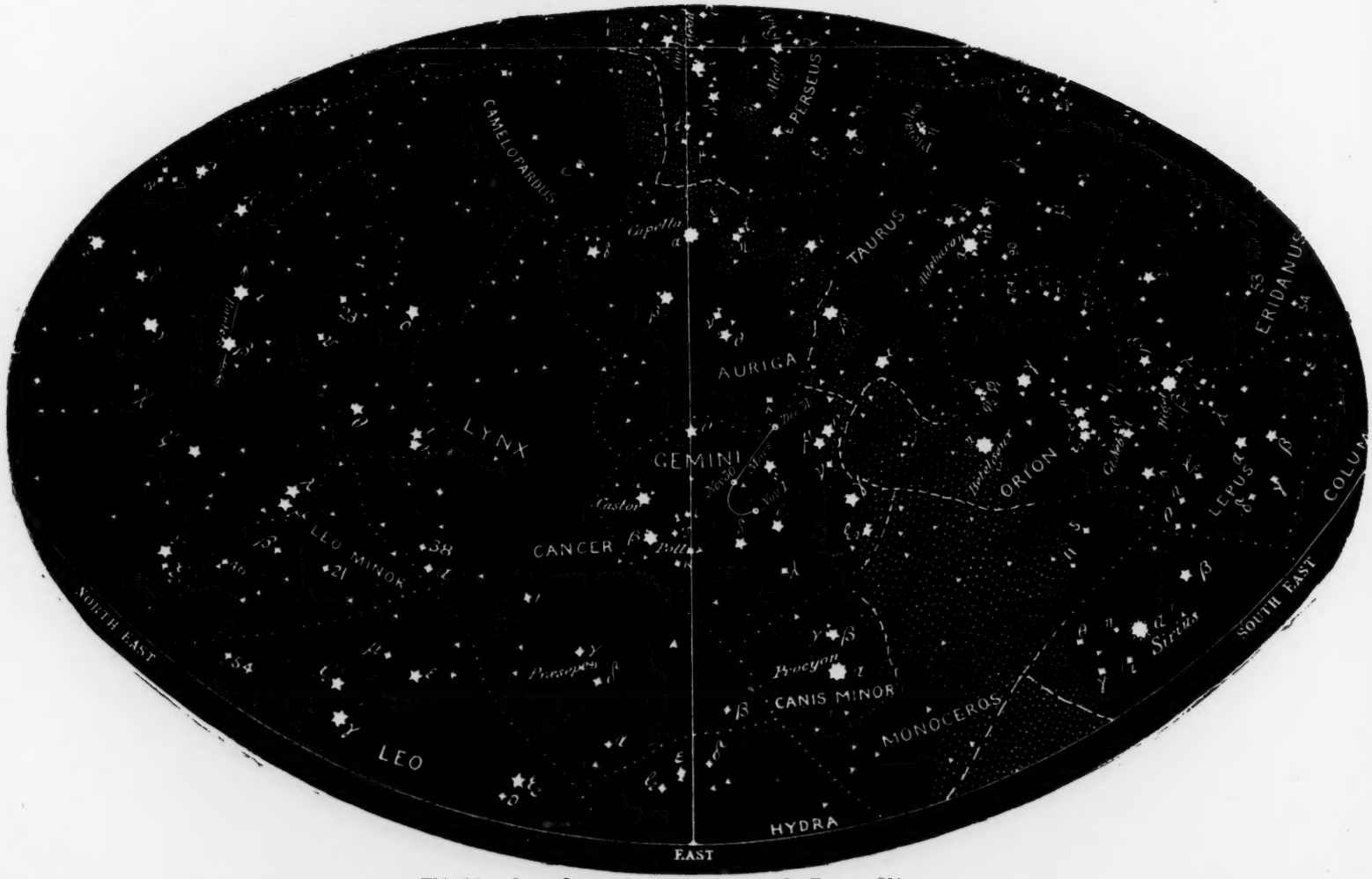
Mabel Winfred Laing.

PHRENOLOGY.

[72]—Will you allow me to make a few observations, in answer to the first query contained in letter 32, p. 59, entitled "Phrenology"? "G. P." says: "Assuming that phrenology is all wrong, what are the causes that determine the shape of the head?" I would observe at the outset that if we assume phrenology to be "all wrong," there can be no satisfactory explanation given of the diversities in the shapes of heads. A common answer to the query, "Why are no two heads alike?" is, "Why are no two faces or hands alike?" The simplest answer to this last seems to be, that no two human natures are alike, and this will apply to the first also, when we consider that the varieties we discover in the

[*Continued on page 99.*

THE EASTERN SKIES IN DECEMBER.



This Map shows the position of the stars in the Eastern Skies; —

On November 30, at 10½ o'clock.	On December 8, at 10 o'clock.	On December 16, at 9½ o'clock.	On December 23, at 9 o'clock.	On December 30, at 8½ o'clock.
On December 4, at 10¼ o'clock.	On December 12, at 9¾ o'clock.	On December 19, at 9¼ o'clock.	On December 27, at 8¾ o'clock.	On January 3, at 8¼ o'clock.

The movements of the planet Mars, which is travelling in this part of the stellar heavens at present, are indicated by the curved line marked with this planet's name. We show its path during the last month as well as December. He is now retrograding at his greatest rate. He passes his opposition, or is exactly opposite the sun, so as to come due south at midnight, on December 27. The stars in the Eastern skies are passing upwards from the horizon, moving aslant, from left to right.

*** Stars of the first magnitude are shown with eight points, those of the second with six, of the third with five, of the fourth with four, of the fifth with three.

XUM

Continued from page 96.]
shape of the head are the same varieties that exhibit themselves in the whole external form of man. Now, if these differences of bodily structure are marks of diversity of nature, the inequalities of the skull (which cannot be exempt from the process) will also indicate the same, or to come to the point, will indicate diversity of brain conformation, which is just the doctrine of phrenology. Assuming it to be established, then, that the "cause that determines the shape of the head" is peculiar conformation of brain, the pertinent remark of Professor Lawrence forms a fitting supplement:—"If the mental processes be not the function of the brain, what is its office? In animals, which possess only a small part of the human cerebral structure, sensation exists, and in many cases more acute than in man. What employment shall we find for all that man possesses over and above this portion—for the large and prodigiously developed human hemispheres? Are we to believe that these serve only to round off the figure of the organ, or to fill the cranium?"

With regard to the opinion of Mr. G. H. Lewes, that the brain acts as a whole, and that its functions are not localised, one merely requires to point to Dr. Ferrier's researches in cerebral physiology, by which it has been proved that the *individual convolutions are separate and distinct organs.* A. B.

POPULAR ELECTRICITY.

[73]—I write to suggest that now that electricity is becoming of such vast importance in the world, it is very desirable that a sound elementary knowledge of its principles should be widely disseminated, and that KNOWLEDGE might be an available medium for contributing to this result. Would it not be a good thing that a series of papers on this subject (including magnetism) should be published in KNOWLEDGE? The papers should be simple, and should suggest experiments which any person of intelligence might try for himself without elaborate or expensive apparatus. Something in the style of Tyndall's "Lessons on Electricity," but extending, of course, to current electricity. I venture to think that such a series, if produced by a competent hand, would be extremely popular with young people, whose desire for information in this direction is very great.—Yours, &c., DANIEL JONES.

COMETS' TAILS.

[74]—I have read with great interest your excellent paper on Comets, but am sorry to find no other theory can be introduced to account for the tails always pointing away from the sun, except that of solar repulsion. Such a theory, I am sure, should not be adopted without the most conclusive and perfect evidence of its existence; because, if we introduce a resisting medium into the solar and stellar system, we see in it the germs of its own destruction, which, although for a time making no effect upon the movements of the ponderous planets, must, in the end, make itself felt, even though that medium be of the rarest tenuity. I once heard a theory propounded, that comets were simply lenses, and the sun shining through them produced the appearance of a tail; that might apply to telescopic comets, without any indication of a nucleus, but not otherwise, for Sir John Herschell tells us the nucleus of a comet is opaque. The theory is, as far as I know, a novel one, and the readers of KNOWLEDGE must judge for themselves of its value.—Yours, &c., J. D.

THE SUN'S DISTANCE.

[75].—The latest determination of the velocity of light, by Michelson, gives 186,305 miles per sec. *in vacuo.* Supposing that the time interval for the passage of light across the major axis of the earth's orbit, which is given as 986·6 secs., may be relied on to the $\frac{1}{10}$ part of a second, as is likely, considering the numerous and accurate observations on Jupiter's satellites; may not the deduced semi-axis of the earth's orbit, which is 91,904,256 miles, be trusted as far as the first four figures? The corresponding parallax would be 8″·895, round which all the best determinations seem to centre, such as 8″·88 from transit of 1874, 8″·91 by Hanen's lunar method, 8″·894, and 8″·855 from observations on Mars. It appears that Michelson's method, which is based on an extension of Foucault's, gives a result which may be relied on almost down to the unit's place: for the interval to be measured was the passage of light over a distance of about 4,000 yards, and the direct deviation obtained was about 150 times that obtained by Foucault.—Yours, &c.

Marlborough College, Nov. 19, 1881. H. L. CALLENDAR.

[Considering the somewhat wide discrepancies between the observed time of appearance and disappearance of Jupiter's satellites, according to the telescope employed and the observer's eyesight, we should be disposed to doubt whether the method referred to can be trusted as likely to give results to the degree of accuracy you mention. Aberration is regarded as more trustworthy.—ED.]

THE METRICAL SYSTEM.

[76]—Sir W. Thompson, in his address at York, referring to the metrical system, says, "to it we are irresistibly drawn in all scientific and practical measurements, notwithstanding a dense barrier of insular prejudice most detrimental to the islander."

It would be superfluous to enlarge here upon the many advantages of the metrical system of weights and measures which are set forth and explained in so many elementary treatises; but if you could find space in your columns for two or three examples, illustrating the saving of labour that their adoption would introduce into the computations of every-day life, I cannot but think that you would make converts, and by facilitating calculation, promote accuracy, the stepping-stone to all knowledge.

Take an ordinary example from agriculture:—

A field of 6 hectares, 41 ares, 66 square mètres, sown with wheat, at 250 litres to the hectare, would require

$$6{\cdot}4166 \times 250 = 1{,}543{\cdot}8500 \text{ litres,}$$
$$= 15 \text{ hectolitres, } 44 \text{ litres of seed.}$$

If the wheat is of specific gravity 0·80, the whole quantity would weigh $1544 \times {\cdot}80 = 1235{\cdot}2$ kilogrammes.

Again, the seed required would be

2·5 litres for every are,
or 0·25 litres for every square mètre.

Let the same field be ploughed up to the depth of 2 decimètres (nearly eight inches), and suppose that the specific gravity of the soil is 2, every square mètre of the soil ploughed up will weigh $2 \times 2 \times 100 = 400$ kilogrammes, and the whole soil of the field ploughed to the depth of 2 decimètres will weigh

$$64{,}166 \times 400 = 25666400 \text{ kilogrammes,}$$
$$= 25666{\cdot}4 \text{ metrical tons.}$$

It then becomes very easy to compute the proportion of any manure to the available soil.

Let the amount of manure applied be 1,000 kilogrammes per hectare:—

1000 kilogrammes per hectare
= 10 kilogrammes per are
= 100 grammes per square mètre
= 1 gram per square decimètre, or 2 cubic decimètres of soil.
$= \frac{1}{4000} = {\cdot}00025.$

If the amount be 600 kilogrammes per hectare
= 6 kilogrammes per are
= 60 grammes per square mètre
= ·6 gram per square decimètre
$= \frac{{\cdot}6}{4000} = {\cdot}00015.$

When great accuracy is required, the use of logarithms will, of course, much facilitate the calculation, but they may be dispensed with for ordinary practical purposes. Now, let anyone try to work out such simple problems with a field of the same size expressed in English measures, viz., 15 acres, 3 roods, 17 poles, and the seed sown at 3 bushels per acre. He will see what an amount of labour they involve. Indeed, at the outstart, we are met with such an anomaly as this, that while the yard is our standard measure of length, few persons could give the length of the side of a square statute acre, such side being 69 yards and a long fraction (69·5701). Nor is the matter much facilitated when we find that 30¼ square yards go to one pole.

Should you think these remarks not too technical, I shall recur to the subject with some other examples in a future number, and beg to subscribe myself, yours, &c.,

MICROCRITH.

[We thank "Microcrith" for his excellent illustration of the value of the metrical system. It is actually easier in dealing with the second form of the above problem to convert the English measures into the metrical system, then to work the problems as "Microcrith" has done, and to turn the answers into English measures, than it is to work them throughout with the English measures.—ED.]

CAUSE OF GRAVITY.

[77]—In your note to letter No. 31 (page 59) on this subject, it is stated as a "demonstrated fact that the action of gravity is communicated far more rapidly than light travels." I beg to ask an explanation of this, as I was not aware that the action of gravity was "communicated" at all in the sense of "travelling" (or of crossing over a space during a greater or less lapse of time). As far as my present knowledge goes, the statement reminds me (I give

this to illustrate my particular difficulty) of the remark of a friend who said he knew something which "travelled" quicker than light, and on being asked to explain, answered *sight*. I had some difficulty in explaining to him that sight was merely a mental interpretation of sensation produced on a *passive* organ by the light which had already "travelled" from the distant object to the organ in question.

Unless I have been misinformed, the present tendency of scientific thought is to do away with the idea of "attraction" altogether, as a figment of the intellect. What we call gravity, or any other form of so-called attraction, is merely the tendency to fall in the direction of least push. Thus, suppose a railway truck between two engines tending to push it in opposite directions. It cannot move both ways at once. It therefore moves in the direction of the weaker engine. Something analogous to this is the modern explanation of attraction so-called. A stone falls to the earth because the pressures exerted on it are least in the direction of the earth—no attraction at all in nature—all push and strife.—Yours, MUDDLESBROUGH.

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[78]—I was much gratified to find this question raised in the last number of KNOWLEDGE. It is an exceedingly interesting subject, and one I would like to see treated in a competent manner. In an article by yourself, entitled "The Mystery of Gravity," you intimated that you might at some future time describe a method by which gravity might be generated and propagated, founded on the views of Le Sage. I write from memory, and therefore cannot be certain of the exact words. Will you kindly say whether this promise has ever been fulfilled? If not, would you kindly favour the readers of KNOWLEDGE and myself by stating your views on this truly great question.—Yours, &c., T. J. HICKIN.

ELECTRICAL BELLS.

[79]—As a subscriber to your promising weekly, I have come across the extract from the *Times*, No. 1, page 14, wherein the writer recommends electric bells for private houses.

I beg to say from long experience, electric bells are very troublesome in private houses, however they may answer in hotels, where there is generally a *yearly charge* to keep them in order.

There is a better system in use in Government offices, and that system is the pneumatic, which is so simple and durable, that I wonder the *Times* should ignore "pneumatic" while writing up "*electric*."

I have pneumatic in my house, and the excellency of the whole arrangement is, beyond question, worth bringing to the front, certainly quite as much so as electric is by the *Times*. There is no battery nor anything whatever to attend to.—Yours truly,

M. TESTER.

THE FIFTEEN PUZZLE.

[80]—I enclose a *short* proof, which I gave in the *Brighton Herald* for May 22, 1880.

Take 15 tickets, numbered from 1 to 15, and arrange them in a row in any order. Let every instance in which a lower number is further on in the series than a higher number be called a disarrangement. Note whether the number of such disarrangements is even or odd. A cyclic interchange of any odd number of the tickets will make an even difference in the number of disarrangements, and, therefore, no combination of such interchanges can convert an order with an odd number of disarrangements into an order with an even number of disarrangements.

Now arrange the 15 tickets in a square, and bring the blank space to the place it is to occupy finally. Then after this, the game consists of the travels of this blank space over the board, finally ending where it started. The route pursued consists partly of tracks followed and again retraced, which make no ultimate difference to the number of disarrangements—and partly of closed paths travelled round, which are cyclic interchanges of an odd number of tickets. No number of such operations can make the number of disarrangements zero if it happened originally to be odd.—Yours, &c., ARTHUR BLACK.

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[81]—As you invite correspondence, I send you the enclosed very remarkable arrangement of figures. A year or two ago I sent them to the publisher of juvenile books. I believe it was not attended to. If so, I am of opinion that it is unknown.

At first sight it seems a confusion of figures; but, on examination, the arrangement will be found to be very simple.

You will perceive that the unit 1 is placed under the central square; if you follow the figures to the end, all confusion will vanish. To understand it is a very different thing.

West Brompton, *Nov.* 11, 1871. H. S.

The square of *all odd* numbers may be so arranged that the totals of all the columns—perpendicular, horizontal, and diagonal—shall be the same. And the totals will be the *larger* * half of the square *multiplied by the odd number*. Thus the totals of—

$5 \times 25 \div 2 = 13 \times 5 = 65$, the total.
$7 \times 49 \div 2 = 25 \times 7 = 175$,,
$9 \times 81 \div 2 = 41 \times 9 = 369$,,
$11 \times 121 \div 2 = 61 \times 11 = 671$,,

SQUARES OF "ODD" NUMBER.

5 *totals* = 65.

11	24	7	20	3
4	12	25	8	16
17	5	13	21	9
10	18	1	14	22
23	6	19	2	15

Square $25 \div 2 = 13 \times 5 = 65$, the totals.

7 *totals* = 175.

22	47	16	41	10	35	4
5	23	48	17	42	11	29
30	6	24	49	18	36	12
13	31	7	25	43	19	37
38	14	32	1	26	44	20
21	39	8	33	2	27	45
46	15	40	9	34	3	28

Square $\frac{49}{2} = 25 \times 7 = 175$, the totals.

9 *totals* = 369.

37	78	29	70	21	62	13	54	5
6	38	79	30	71	22	63	14	46
47	7	39	80	31	72	23	55	15
16	48	8	40	81	32	64	24	56
57	17	49	9	41	73	33	65	25
26	58	18	50	1	42	74	34	66
67	27	59	10	51	2	43	75	35
36	68	19	60	11	52	3	44	76
77	28	69	20	61	12	53	4	45

Square of $9 \times 81 \div 2 = 41 \times 9 = 369$, the totals.

[This is a known method of making magic squares. We find in the magic square for the numbers 1 to 9; thus:—

4	9	2
3	5	7
8	1	6

in which also other methods of solution are indicated.—ED.

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* The *larger* half means the actual half plus a $\frac{1}{4}$.

Queries.

[29]—GARDEN TRIPOD STAND FOR TELESCOPE.—Could any of your readers tell me how to make a cheap garden tripod stand for a 3-in. glass, and where to get the several parts? The cheapest I can buy is £1. 1s., and that seems so dear for so simple a thing.—IGNORAMUS.

[30]—SOLAR HEAT.—With respect to the sun being hot, will you kindly explain to me why some countries are warmer than others? If it is because they are nearer the sun than the cold ones [but it is not—ED.], why, then, should not the top of a mountain be warmer than the bottom? On a man going into a tropical country, he naturally gets brown-burnt by the sun (?). Does the sun act directly on the man, or does it first enter the earth, and the man, as it were gets the reflection?—WARMUS.

[31]—INTENSITY COILS.—Can you inform me how to estimate the maximum battery-power which may be used with any given intensity coil, without incurring the risk of destroying the insulation? Can you afford me any practical hints as to the best way of restoring one so damaged without having recourse to a coil-maker? I presume it will be necessary to replace the secondary coil with a new one—but how?—Δ.

[32]—ENGRAVING ON COPPER.—Want to know the usual method of engraving on copper, what the plate is covered with, and the materials used? Is it sulphate of copper and salt, or what? Engraver cannot get any cheap handbook bearing on the subject.—ENGRAVER.

[33]—ASTRONOMICAL SLIDES.—Can any of your readers give me a few hints how to prepare the above for a lecture on popular astronomy; also, how to make a good opaque black for same?—C. J. S.

[34]—THREE-HANDED CHESS.—Can any of your readers inform me of a way of playing chess with three players only? The four-handed game is well known to me.—GEO. H. VERNEY.

[35]—With reference to the calculations concerning the four asteroids and the magnitude of the third satellite of Jupiter, have there been found any great differences since 1846?—S. S. S. S.

[36]—LAPLACE'S THEORY.—Do you consider Laplace's conclusions with reference to the physical forces and evolution sound, as far as we now know?—S. S. S. S.

[37]—VESTIGES OF CREATION.—Who is the author of "Vestiges of the Natural History of Creation," and do you consider it reliable?—S. S. S. S.

[38]—DENSITY OF NEPTUNE.—What is the density of the planet Neptune, and how many of his satellites have been discovered?—S. S. S. S.

[39]—THE MOON'S ROTATION.—The moon turns once on its axis in exactly the same time that it takes to revolve once round the earth. Is there any law or theory as to the cause of this, or is it a mere coincidence?—C. O. K.

[40]—FINE DRILLING.—Professor Edward C. Pickering, of Harvard College, says that in undertaking to measure the intensity of the light of the satellites of Mars, he had occasion to need an extremely small hole. Among the artisans who essayed to furnish what was required was one who had succeeded in making a hole edgewise through an old-fashioned three-cent piece, and another who had pierced a needle through from end to end. A hole about the twenty-five-hundredth part of an inch in diameter was finally secured.—(*Public Opinion*, Nov. 19, 1881, p. 658.) Have you any knowledge of the above? Assuming that there is no mistake, an account of the mechanism employed, and of the boring instrument, would be of interest.—A. T. C.

[41]—THE PLANET VULCAN.—Is anything more known of the planet Vulcan; and is it believed to be certainly in existence?—S. S.

[42]—MAGNETOSCOPE.—Is there any instrument made for the purpose of measuring the amount of magnetism, and also electricity in the human body? I think I have heard of a "magnetoscope," but know no particulars.—S. S.

[43]—B.Sc. AND D.Sc. EXAMINATIONS, LONDON UNIVERSITY.—I am desirous of obtaining such a knowledge of science as would enable me to answer such questions as are set in the B.Sc., and even the D.Sc. examination papers of the University of London. What books would you recommend for this purpose? I shall be extremely obliged for an answer to this.—AN ENTHUSIAST.

[44]—ILLUMINATION OF THE SOLAR SYSTEM.—May I, as a reader of KNOWLEDGE, request you to give me and my fellow readers some sound instruction on the subject of the new theory started by Mr. Collyns Simon, on the "Solar illumination of our system"? I have seen attention called to it by several foreign periodicals, but none by the English. Are we to accept it as possible, or reject it as impossible?—V. A. T.

[45]—CAUSE OF GRAVITY.—What is the cause of gravity? There is an interesting article, if I recollect rightly, in the old "Encyclo. Lond.," giving the views of Sir Richard Philips on this matter. Philips believed that all the phenomena attributed to attraction might be accounted for by the laws of motion.—METER.

[46]—PLANETARY RINGS.—Are these not evidences of matter more or less plastic beyond the solid planetary nucleus, the phenomena presented by the denser and cloud portions of the atmospheres of planets, ranging themselves centrifugally, in belts? This globe, in my view, would appear belted in other planets. This explanation might be illustrated experimentally.—METER.

[47]—OPTICAL ILLUSIONS.—Are these not all due to the simple law of contrast?—METER.

[48]—TRISECTION OF AN ANGLE.—I shall be glad if any of your readers can inform me how to trisect *any* angle. A small diagram will greatly assist.—EUCLID.

[49]—LIFTING MAN'S WEIGHT.—Could you kindly inform me how it is that four men appear to lift a fifth so easily when they all inspire their breaths together? Is it simply a trick, or is there some scientific explanation of it? I should esteem it as a favour to have an answer in your next issue.—D. H. B.

[50]—WASTED ENERGY?—A certain amount of energy is supplied to an electric lamp in the form of current electricity. A small part reappears as heat, the rest as light. What form does the energy radiated as light vibrations take as the light is constantly absorbed by surrounding objects?—A. H. H.

[51]—BOTANY LECTURES.—Can the Editor or a reader of KNOWLEDGE tell me of any first-class lectures on Botany, embracing such subjects as are not included in the ordinary lectures given at the various science schools, but are required for the S. and A. Honours Exam.? Do not any of the masters of the subject teach, either by lecture or correspondence?—NEMO.

[52]—MICROSCOPE.—Can anyone oblige by recommending what they consider from experience to be the best microscope for botanical and biological work; cost, with all necessary appliances, not to exceed £10.?—NEMO.

[53]—SUGGESTION.—BOTANICAL PAPERS.—If the Editor of KNOWLEDGE should see fit to introduce into his useful and interesting paper a series of articles on botanical subjects, I think many readers would welcome them with pleasure, as the subject is one that is now so widely studied, and the new discoveries and theories of the learned do not appear in the text-books till long after date. A column devoted to this subject would surely be as appropriote to KNOWLEDGE as a chess or whist column.—NEMO.

[54]—CHEMICAL QUESTIONS.—1. In testing a solution of ferrocyanide of potassium with chloride of ammonia, ammonia in excess, and hydrosulphuric acid, no precipitate was obtained. Could you explain why no precipitate was thrown down, since iron is one of the third group of metals? 2. Strong solutions of bisulphate of potassium and potassic iodide were separately treated with tartaric acid. No effect, even when stirred on a glass surface. Why was there not a white precipitate following the course of the stirring-rod?—CASTOR AND POLLUX.

[55]—FUTURE OF GREEK VERBS.—Is there any rule for the lengthening or otherwise of the vowel when forming the future of a pure verb in Greek. For instance:—

Φιλεω	makes	Φιλησω
καλεω	,,	καλεσω
τιμαω	,,	τιμησω
ὁραω	,,	ὁρασω

Why should the ε be lengthened to η in Φιλεω and not in καλεω?—CASTOR AND POLLUX.

[56]—CAN you kindly recommend a book covering the chemistry for the South Kensington Honours Syllabus?—CASTOR AND POLLUX.

[57]—THE GREAT BEAR.—In what latitude would this constellation become invisible for three months of the year, by dipping below the northern horizon? Is the upper pointer (Dubhe) the most western star of the constellation, and the tail star (Benetnasch) the most eastern? What is the difference of celestial longitude between the most eastern and most western stars of the constellation—*i.e.*, how many hours and minutes of longitude does the Great Bear spread itself over? The Sûrya Siddhâuta, a text-book of Hindu astronomy, which seems to teach a modification of the Ptolomean system, attributes to this constellation a cycle of 2,700 years. The translator (Rev. Ebenezer Burgess) is at a loss to know what this refers to. Can you solve the difficulty?

XUM

Has the Great Bear been made use of by any people for measuring time, in connection with the Dog-star or any other? Bentley, in his Hindu Astronomy, says that the Hindus had the following method of measuring the amount of *precession*: They assumed an imaginary line, or great circle, passing through the poles of the ecliptic and the beginning of one of their lunar asterisms called *Magha* (instead of twelve solar signs, they had twenty-seven lunar asterisms). This great circle, which was called the line of the Rishis, was supposed to cut some of the stars of the Great Bear, and the precession was noted by stating the degree, &c., of any *movable* lunar asterism cut by that fixed line or circle as an index. That is to say, their asterisms shifted, precessionally, just as our "Aries" has got into Pisces, and they measured the amount of precession by the passage of the asterisms over the assumed fixed line. This fact suggests to me to ask whether the Egyptians made out any similar connection between the Great Bear and Sirius, or between the Pole-star and Sirius. I know that a line drawn through "the pointers" would not pass through Sirius, because the Right Ascension is so different; but is any sort of connection known to have existed?—George St. Clair.

[58]—Sirius and Orion.—I have met with a statement that Sirius is in the shoulder of Orion. Knowing that Sirius was in the Great Dog constellation, I was puzzled. Did the Orion constellation at any time include Sirius?—Geo. St. Clair.

[59]—Mercury's Revolution.—The "Science Primer on Astronomy" (by J. Norman Lockyer, F.R.S.), p. 62, says that Mercury is 84 days in traversing its orbit. Most books which I have looked into give Mercury's sidereal revolution as 87 days 23 hours 15 minutes 43 seconds. Is the sidereal revolution something different from the "traversing of the orbit?"—George St. Clair.

[60]—Sound.—How does sound penetrate through a brick wall?—S.

[61]—Will the Editor, or anyone else, inform me the name of the great comet that appeared in our northern sky this last midsummer; also, how long it takes to make one journey round the sun?—S. C. H.

[62]—Algol.—Where abouts in Persius is the variable star Algol? If this is the same star as in the head of Medusa, I suppose the latter constellation is a part of the former. Is it so?—F. H. S.

[63]—Algol and Mira.—When are Algol and Mira at their brightest?—F. H. S.

[64]—Star Letters and Numbers.—Not having examined a stellar map before those that appear in Knowledge, will you kindly explain the following? I have been under the impression that the stars of all constellations are named after the Greek letters, and when these are exhausted, the numerals are then resorted to, beginning, of course, at 1? I find this is not the case, *e.g.*, take Lynx, as marked in the map on No. 1. The brightest star is of the fourth magnitude, and is α; there are only two others marked in this constellation, but instead of their being β, γ, or 1, 2, they are called 31 and 38.—F. H. S.

[65]—New Star in Cassiopeia.—I am told that a periodical star in Cassiopeia will shortly appear, and it will be so bright as to be seen at noonday. Is that so?—F. H. S.

[66]—Has Venus ever been seen in the daytime?—F. H. S.

Replies to Queries.

[11]—Logarithms.—Without knowing the extent of accuracy desired by Mr. Grundy (query 11, p. 60) in his computations, it is difficult to advise him as to the class of tables he requires. Copies of the ordinary "Seven-place" tables of Hutton, Babbage, Sang, and others are easily procured second-hand (the first for preference); German tables to six places, by Ursinus and Bremiker, can be purchased at Nutt's; and the best of several five-place logs. will be found in Galbraith & Haughton's series, now published by Cassell. This includes a table of "Sum and difference" logs. by Gauss. The last table is made specially applicable to Life contingencies and the general formation of tables by a continuous method, by P. Gray, who inserts it in his "tables and formulæ," tabulating for each log. that of the function $1+x$. An error in Babbage may here be noted. In the eight-figure series attached to his larger table, the log. of 103 (an important figure, as being the initial 1, plus its interest at 3 per cent.) should be 01283722, not 01283723. The most complete table of Anti-logarithms is the old folio of Dodson, frequently to be picked up at the stalls; see also Shortrede's tables to seven places in the usual form.—Yours faithfully,

H. S. A.

[19]—Comparative Anatomy of Birds and Animals.—Charles Sherborn asks, What are the corresponding bones in man and other mammals to the "furcula" (*furculum*) of birds? I am surprised Mr. Sherborn has not discovered the answer to his query in any good manual of zoology. The "furculum" of a bird (*anglicè*, the "merry-thought") is composed of the two collar-bones or clavicles of the bird, which are, in most cases, firmly united to form one bone. This bone, in turn, is joined to the breast-bone, and forms a strong arch, or, rather, keystone, of the shoulder. It should be remembered that in a bird's shoulder there are three typical bones—scapula, or shoulder-blade; clavicle, or collar-bone; and coracoid bone—on each side. The coracoid bone, developed as a distinct bone in birds, reptiles, and lower vertebrata, is represented in all mammals, except the lowest, as a mere process (coracoid process) of the shoulder-blade. In the lowest mammals (*e.g.*, *Ornithorhynchus* and *Echidna* of Australia) the coracoid, as in the bird, is articulated with the breast-bone. In this respect, as well as in the absence of sutures or distinct lines of union between the skull-bones, and in other joints of internal anatomy, the lowest quadrupeds present a striking affinity to birds.—Andrew Wilson.

[25]—Forms of Food.—As explanatory of the terms relating to food in Dr. Carpenter's paper, which puzzle "Desdichado," I would advise him to read a simple elementary treatise wherein foods at large are treated. Such a book as Corfield's "Laws of Health," 1s. 6d. (Longmans), will assist him. Foods are divided into (1) Nitrogenous (containing carbon, hydrogen, oxygen, and nitrogen, and sometimes sulphur and phosphorus) and (2) non-nitrogenous. Of the latter, there are four chief varieties:—(1) Water (H_2O); (2) fats and oils (CHO); (3) sugars and starches (amyloids or hydro-carbons) (CHD, but differing from fats in the amount of O they contain); (4) minerals (*e.g.* lime, salt, iron, &c.) "Desdichado" will obtain all necessary information concerning foods from any primer of physiology, and such knowledge should form, indeed, part of every system of school training.—Andrew Wilson.

TRAINING.

We have before now spoken of the singular views which have prevailed with regard to the diet best suited for men who were desirous of developing their physical powers to the highest degree, and of the harm which has been done by the empirical, and in many cases ridiculous, rules which were laid down. Some of the most objectionable of these are now happily set aside, and the opinions of those intelligent persons who taught that mutton was better than beef for "wind," that all fluids should be avoided by men who wish to "get into condition," that meat was to be eaten without salt, and that pedestrians should drink sherry and boxers port, would be laughed at, even by the most ardent fanatic in an Eight; but, though a good deal of nonsense has been got rid of, a bad system still prevails, and there is no exaggeration in stating that harm is still done by the regulations respecting diet which, even in these days, are unhesitatingly obeyed. At one time, no doubt, some of these rules appeared to have a certain scientific sanction; but it has now been well established that the views on which this sanction was based were not only erroneous, but directly opposed to the truth. In so far, therefore, as rules which are in accordance with them have any effect, they must have a bad effect. It is true that they do not work so much ill as might be expected, but this is because the men who follow them are usually very young, very vigorous, and lead, apart from diet, a most healthy life. Still, unless modern physiological teaching is altogether wrong, even the modified system now followed must cause some evil, and the sooner it is swept away the better. If it be said that the men who train steadily often attain very "high condition," the answer is that this is due in no way to their food, but to constant and fitting exercise in the open air, to regular hours, to strict temperance with regard to alcohol, and to abstinence from, or great moderation in, smoking. Strength is attained not by diet, but in spite of diet.

That erroneous views should at one time have been held is not wonderful, for in support of them the great name of Liebig could be quoted by those who had sufficient energy and intelligence to attempt a scientific study of the question. It is now, however, well established that in some of his conclusions Liebig was wrong, and notably that he was wrong in thinking that muscular or mechanical effort was entirely supported by nitrogenous food, and that the heat-giving foods sustained the process of combustion which is constantly going on in the body, but did nothing more. If he was right, of course, the more muscular work a man did, the more nitrogenous food he would require; and trainers were therefore not mistaken in favouring meat, and in looking with great dislike on those foods which are commonly thought to produce fat; but then, unfortunately, Liebig has been shown to have been in error, and any system of diet which is in accordance with his views cannot be a good one, and is in all probability a very bad one. The

erroneous nature of views based on Liebig's doctrine is well known to physiologists; but, nevertheless, is hardly as yet so generally known as it ought to be, and very likely on the banks of Isis and Cam there is no suspicion of the truth. Possibly every year a certain number of men break down in training, with more or less injury to their constitutions, owing to a faulty diet. Instruction on this subject is therefore anything but superfluous, as a deeply-rooted error is not by any means eradicated; and all who are interested in athletic sports should welcome the appearance of two articles which a writer on physiology of the first eminence has contributed to Mr. Richard Proctor's new magazine, KNOWLEDGE—a periodical, we may observe, which promises to satisfy a want that has long been felt. In this magazine Dr. Carpenter has come forward to protest against the belief in Liebig's views which appears unfortunately still to exist. As need hardly be said, he does not write specially on training or diet, but generally respecting food material and physical effort, his articles being on "The Relation of Food to Muscular Work." They are written with all his accustomed clearness and powerful simplicity, and we hope to aid in calling attention to them, as they cannot fail to do much good if they reach those who habitually misfeed young men with a view to producing "high condition."

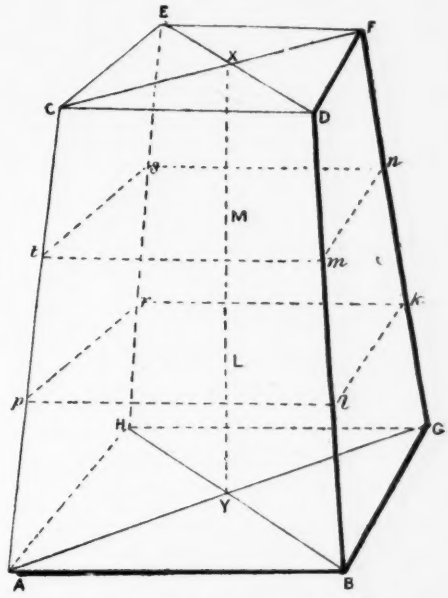
It is not necessary to reproduce here the careful and minute account which Dr. Carpenter gives of the process involved in muscular effort. Those who wish to understand this must seek the pages of KNOWLEDGE, and they will be very well repaid for their pains. His summing-up, however, which states briefly the views of modern physiologists, should be given in his own words, which are as follows:—

"The *mechanical working* of the body of a living animal is as directly dependent as its *heating* upon the oxidation of the hydrocarbons of its food; and these may be most economically supplied by non-nitrogenous substances. On the other hand, the mechanism can only be kept in working order by the continual renovation of its substance (its very existence as a living whole involving the continual death and decay of its component parts); and for this renovation a supply of *proteids* is essential, with a certain admixture of *fat* to serve as a material for protoplasm."

Now it is scarcely necessary to point out how entirely these truths are opposed to the system followed in training, which did seem to receive some kind of sanction from Liebig. It is true, no doubt, that nitrogenous food is required for the renovation of the muscle, which wears out as all the tissues of the body wear out; but the consumption of muscle caused by effort—which, as we have said, has been likened to the wear and tear of a machine—is small when compared with the consumption of the non-nitrogenous substances, which represent the fuel that is burnt to maintain the force developed. It is therefore clear that when there is severe and continuous physical effort, a large supply of the latter kind of food-material will be required to make good the loss occasioned by that effort, while of the former only a slight increase will be made necessary. The principle followed in training is exactly to reverse things. It is true that men are no longer encouraged to gorge themselves with underdone meat and to avoid sweets as if they were poison; but still, in the main, the trainer favours meat, and watches with some jealousy and restricts the other kinds of food. He ought to do just the opposite. We do not, of course, mean to say that the resources of the French *cuisine* should be placed at the disposal of young men in training, as it is sufficiently obvious that those who desire to attain a high state of health must confine themselves to simple and digestible food; but of simple food it is the non-nitrogenous kind that is the most needful, and it is about as reasonable to fear a large proportion of nutriment of this class as it would be to fear the oxygen of the air. Nay, more harm may be done by abstaining from the food indicated. Natural laws cannot be disobeyed with impunity; and when nature points distinctly to one kind of diet, and men choose to adhere to a diet of precisely the opposite kind, evil of some sort is not unlikely to follow. The argument that the diet is right because men who adopt it do get into "high condition" we have already answered, and there can be little doubt that the ailments which assail men in training and the occasionally serious results of training are in part due to a vicious system of diet which, in so far as it has any scientific basis, is founded on a doctrine which is now thoroughly exploded. Much, therefore, do we hope that Dr. Carpenter's valuable contributions to KNOWLEDGE will be read at the Universities and other places where there is devotion to the severer kind of athletics. If these and some other writings are studied, we doubt not that, before long, the foolish rules which still remain will be swept away, and that the happy young athletes who are able to enjoy good and wholesome dinners, which tend to produce, not to retard, the much-desired "condition," will fervently revere the name of the man of science who released the victims of training from an odious thraldom.—From the *Saturday Review*.

Our Mathematical Column.

MATHEMATICAL QUERY [1].—A mason has a block of stone—as in figure.—square at top and bottom. Perpendicular height, $XY = 10$ feet; AB, side of base, $= 8$ feet; CD, side of top, $= 6$ feet. He desires to cut it in three parts of equal solidity. Will one of your mathematical readers kindly tell him an easy way of doing it?—CYMRO.



The practical answer to this question is simply to mark off Bl, Gk, Hr, Ap each equal to 2·783 ft., or to about 2 ft. 9⅜ in.; and lm, kn, rs, pt, each equal to 3·269 ft., or about 3 ft. 3¼ in., and cut off by planes parallel to $ABGH$, the pyramidal frustra pG and tk.

Presumably the block is to be cut by planes parallel to the top and bottom.

The best way of treating this question is, perhaps, the following:—

The block EB may be regarded as part of a pyramid, having $ABGH$ as base. The height of this pyramid would be 40 ft., for its linear dimensions narrow one-fourth in 10 ft. of ascent, and reduce, therefore, to nought (or the vertex is reached) at four times this height.

Of this pyramid, the part or frustum EB has a volume bearing to the volume of the pyramid the ratio $(40)^3-(30)^3 : (40)^3$

$$= 64-27 : 64 = 37 : 64$$

In other words, putting V for volume of pyramid, volume of block $EB = \frac{37}{54} \cdot V$. Now we require to determine two points L and M in YX, so that planes through L and M parallel to $AHGB$ may cut off from the lower part of the pyramid one-third and two-thirds respectively of the volume EB. The volumes thus cut off will, therefore, be respectively—

$$\frac{1}{3}\cdot\frac{37}{64}V \text{ and } \frac{2}{3}\cdot\frac{37}{64}V, \text{ or}$$
$$\frac{37}{192}V \text{ and } \frac{74}{192}V$$

Now, if L and M be respectively distant x and y feet from the vertex of the pyramid, we have the volumes cut off from the lower part of the pyramid by the planes through L and M, respectively equal to—

$$\frac{(40)^3-x^3}{(40)^3}V \text{ and } \frac{(40)^3-y}{(40)^3}V$$

Hence $\frac{(40)^3-x^3}{(40)^3}=\frac{37}{192}$; and $\frac{(40)^3-y^3}{(40)^3}=\frac{74}{192}$

or $x^3=\frac{64000\times 155}{192}=\frac{155000}{3}=51666\cdot\dot{6}$

and $y^3=\frac{64000\times 118}{192}=\frac{118000}{3}=39333\cdot\dot{3}$

XUM

We can readily obtain approximate solutions by logarithms, thus:—For x, we have:—

log. 51666·67 = 4·7132104
one third of which = 1·5710701 = log. 37·245
whence x = 37·245 feet,
and $YL = 40 - x = 2·755$ feet.

For y, we have:—

log. 39333·33 = 4·5947608
one third of which = 1·5315869 = log. 34·008
whence y = 34·008 feet,
and $YM = 40 - y = 5·992$ feet.

Thus—

$YL = 2·755$ ft.; $LM = 3·237$ ft.; and $MX = 4·008$ ft.

In practice, I suppose it would be more convenient to know whereabouts the planes of section respectively cut the lines *DB*, *FG*, *EH*, *CA*. For this purpose all we have to do is to divide each of these four lines in the same proportion as the line *XY*. This, whether it is done by construction or by computation, is too simple to need further explanation. I may just note, however, that—

$BD^2 : YX^2 :: (40)^2 + (YB)^2 : (40)^2$
$:: 1632 : 1600$
$:: 51 : 50$

so that, for the divisions along *DB*, *FG*, *EH*, and *CA*, the above values for *YL*, *LM*, and *MX* have all to be increased in the ratio $\sqrt{51} : \sqrt{50}$ or approximating as 101 to 100. Increasing them by one-hundredth, we get, supposing *lm*, the required points of division along $DB - Bl = 2·783$ ft.; $lm = 3·269$ ft.; and $mD = 4·048$ ft.

Our Chess Column.

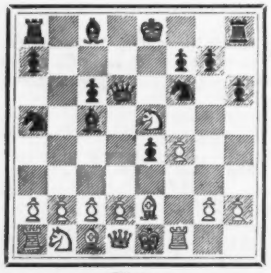
The Two Knights' Defence.

We take next a sounder form of this opening, where Black, instead of retaking the Pawn at his fifth move, plays away his Queen's Knight to Queen's Rook's fourth. The game opens thus:—1. P. to K.4. / R. to K.4. 2. Kt. to K.B.3. / Kt. to Q.B.3. 3. B. to Q.B.4. / Kt. to K.B.3. 4. P. to Q.4. / Kt. to K.B.5. 5. Kt. to Q.R.4. / P. takes P. White has now two lines of play; he may either check with the Bishop or play P. to Q.3, defending the Bishop while leaving it to protect the forward Queen's Pawn. The first, which is the better play, will now occupy our attention. Note, that whatever play is adopted, White's attack is, for the moment, over. He has to provide for the safety of his King's Knight, in attacking which Black can develop his game. The opening proceeds thus:—

6.	B. to Q.Kt.5ch. / P. to Q.B.3.	
7.	P. takes P. / P. takes P.	
8.	B. to K.2 / P. to K.R.3; or	8. B. to Q.R.4 (A)
9.	Kt. to K.B.3 / P. to K.5; or	8. Q. to K.B.3 (B)
10.	Kt. to K.5 / Q. to Q.5; or	10. ——— / B. to Q.3.
11.	P. to K.B.4. / B. to Q.B.4.	11. P. to Q.4. / Q. to B.2.
12.	R. to K.B.sq. / Q. to Q.3. (Pos. 1.)	12. P. to K.B.4 / Castles. (Pos. 2.)

Position 1.

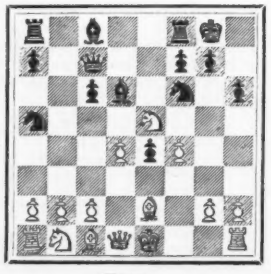
Black.



White.

Position 2.

Black.



White.

In position 1 White, seems to be the better off. Black has his game more open, and, in fact, the attack rests for the moment with him. But the attack does not seem sufficient to compensate for the Pawn which Black has lost. It will be observed that at move 12 Black had to provide against the move P. to Q.B.3, attacking Queen, followed by P. to Q.Kt.4 attacking both Knight and Bishop. He might have done this by playing Bishop instead of Q. to Q.'s third. In this case White would still push Q.B. Pawn, attacking Q., and on her retreating to Q.'s fourth, her best move, would play P. to Q.Kt.'s fourth, with decided advantage. Or Black might have played away his Q.Kt. to Q.Kt.'s second, leaving, however, his Q.B.P. undefended, and on White taking it, Black Queen has to retreat to Q.'s third.

On the other hand, in position 2, Black's game seems as good as White's. He is a Pawn short, but his forces are better situated.

Next week we shall carry on the variations A and B, arising from White's playing 8. B. to Q.R.4, or 8. Q. to K.B.3, instead of B. to Q.2.

Young players will find it a useful exercise to play several games from each of the positions 1 and 2, taking the attack and defence alternately, and, in every case, playing through the opening moves till either position 1 or position 2 is reached.

Instead of 11. P. to K.B.4, by which position 1 is reached at twelfth move, White may play 11. Kt. to K.Kt.4. On this Black takes the Kt. with his Q.'s Bishop, White retakes with Bishop, and Black plays Kt. to Q.B.5. This leads to an even game.

Several of our readers appear to find considerable difficulty with Mr. Healey's little problem at p. 41, two declaring flatly that there must be some mistake. The solution is simply—

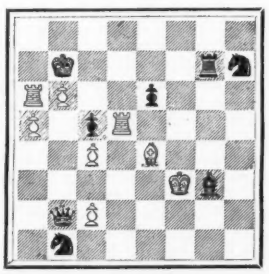
White.	Black.
1. R. to Q.Kt. 7 (ch.)	1. K. to B. sq. (If K. to R. sq., there follows perpetual check, unless K. goes to B. sq.
2. R. to Q.Kt.5.	2. P. Queens.
3. R. to Q.B.5 (ch.)	3. Q. takes R., stalemate.

The other position, and Ponziani's position in our last number, are easy enough. Black's choice is divided between perpetual check and stalemate.

We give, in conclusion, a little problem of our own invention. It presents no difficulty whatever for those who are at all proficient in problem-solving; but may amuse, for ten minutes or so, those who have not given much attention to that department of Chess. (The very feature which makes the problem interesting for these directs the former at once to the solution.)

No. 3.—Problem by the Editor.

Black.



White.

White to play and mate in two moves.

Our Whist Column.

By "Five of Clubs."

Again we give a simple whist game, taken from actual play. It is borrowed from the "Westminster Papers" for 1877. The first player, *A*, was our correspondent (and friendly critic), Mr. Lewis, whose Double Dummy problems long formed so marked a feature of the "Westminster Papers." We give this time *B's* inferences, with notes on the play as before. The game is interesting as showing how a good player may be led by the fall of the cards in the first two or three rounds to lead out trumps even when short in them, and when one of the adversaries probably holds four.

We show also how two tricks might have been saved by correct play of the weaker hands, *Y* and *Z*.

THE HANDS.

Spades—Kn, 10, 3.
Hearts—6, 2.
Clubs—Q, 7, 5, 2.
Diamonds—A, 8, 4, 3.

Spades—Q, 6, 5, 2.
Hearts—A, Kn, 8.
Clubs—10, 9, 8.
Diamonds—10, 6, 2.

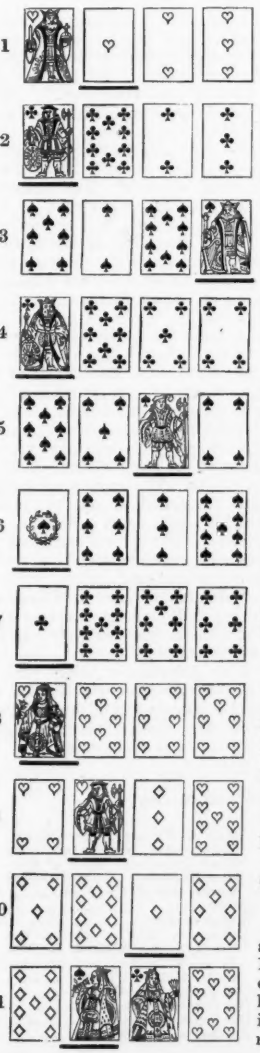
B
Y Dealer. Z
Trump Card, Spades 4.
A

Spades—K, 9, 4.
Hearts—10, 9, 7, 3,
Clubs—6, 4, 3.
Diamonds—Q, Kn, 7.

Spades—A, 8, 7.
Hearts—K, Q, 5, 4.
Clubs—A, K, Kn.
Diamonds—K, 9, 5.

Score:—A B = 0; Y Z = 0.

NOTE.—The underlined card wins trick, and card below it leads next.



B's INFERENCES.

1. *A* has Queen of Hearts and probably two other Hearts; neither *A* nor Z (who has not signalled) is very strong in trumps.

2. *Y* has led from 10 C and two small ones, probably from 10, 9, 8; *Y's* hand must be very weak, but in all probability he has four trumps. *A* has Ace of Clubs and King of Clubs.

NOTE TO TRICK 2.—With such a hand *Y* should have led a trump.

3. *A* has strength enough in trumps, with command in other suits, to justify a trump lead. (This is *B's* inference, and also our comment.)

4. *Z*, if he has played rightly, has no more Clubs. 4 C was the lowest Club in hand, and *Z* cannot have two more, for *B* can place four of the remaining five, viz., 9 C with *Y*, Ace with *A*, and two in his own hand. But *B* knows that 6 C cannot be with *Y*, and if with *A*, then *A* would have originally led Clubs unless holding at least three Hearts besides Ace and King. *B* is for the moment liable to be misled by *Z's* false card.

NOTE TO TRICK 4.—*Z* plays badly in returning his partner's lead when Honours in the suit are declared against them. If leading Clubs at all he should have led 6 C, if only for the sake of uniformity.

5. The Ace of trumps lies with *A*, the Queen with *Y*.

NOTE TO TRICK 5.—*Y* might well have played his Queen of Spades. The Ace certainly does not lie with *B*, and is far more probably with *A* than with *Z*. Even if with *Z* there is the chance of *Z* having also a small trump.

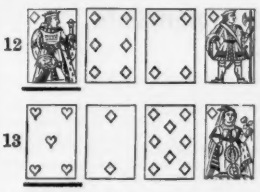
6. The long trump is with *Y*.

7. *Z* played a false card, or at least incorrectly, in trick 4.

8. *A* holds 4 and 5 of Hearts, *see* Trick 1.

9. 10 H is probably with *Z*.

10. *B* knows that *Y* has led from a weak suit, not from King, Knave, 10, for otherwise Y would not originally have led a Club. He knows also that *Z* cannot be strong in Diamonds, or he would not have returned Clubs in which his partner showed weakness. The King of Diamonds probably lies with *A*, as *A* led trumps from so weak a suit as Ace to three. *B* therefore boldly plays his Ace of Diamonds, and with the long Club forces out the long trump.



11. It matters not how *Z* discards. If he discards a Diamond *A* discards 5 H, and wins the remaining tricks, as in the actual game.

A B make three by cards. Had *Y* led trumps at trick 2, or played his Queen of Spades at trick 5, *A B* could have made but two tricks. But the game might have gone better yet for *Y* and *Z* if, *Y* having led as he actually did, *Z* had led 7 H (bad as returning an opponent's lead usually is) at trick 4. This would have fallen to *A's* Queen; and *Y*, knowing *Z* with two more (for he never would have returned opponent's lead unless with four, at least, of the suit originally), would place 9 H and 10 H at once in *Z's* hand (having the 8 himself). *Y* would therefore play away his Knave of Hearts. *A* would have followed with a trump lead as in the actual game, *Y* taking the trick with his Queen. *Y* would not then lead 8 H, because, though his partner could win with 9 H, and then lead the winning Heart, *B* would ruff, lead a Club for his partner to take, who would then lead trumps, &c. But, leading a Club, *Y* would throw the lead again into *A's* hand, who would then have taken out another round of trumps, and playing then Ace of Clubs, as in trick 7 of actual game. If next *A* played a small Heart, *Z* would take the trick with 9 H and another with 10 H. If *A* led a small Diamond, *B*, winning with the Ace, would force the long trump with Queen of Clubs, and on *Y* leading 8 H, *Z* would make both his hearts as before. Or if *B* returned a Diamond instead of leading his Queen of Clubs, then, whether *A* led a Diamond or a Heart after taking the trick with his King, the remaining tricks would be with Y Z. The last five tricks would run in one or other of the following ways, *A* leading in trick 9:—

	A	*Y*	*B*	*Z*	*A*	*Y*	*B*	*Z*	*A*	*Y*	*B*	*Z*
9.	4 H	8 H	3 D	9 H	5 D	10 D	A D	7 D	5 D	10 D	A D	7 D
10.	5 H	2 D	4 D	10 H	4 H	Q S	Q C	Kn D	K D	2 D	3 D	Kn D
11.	5 D	10 D	A D	7 D	5 H	8 H	3 D	9 H	9 D	6 D	4 D	Q D
12.	9 D	Q S	Q C	Kn D	9 D	2 D	4 D	10 H	4 H	8 H	8 D	10 H
13.	K D	6 D	8 D	Q D	K D	6 D	8 D	Q D	5 H	Q S	Q C	9 H

The other eight tricks would be the same respectively as 1, 2, 3, 8, 5, 4, 6, and 7 of the annual game, except that at trick 4, corresponding to trick 8 of the actual game, *Y* would play Knave of Hearts instead of 8 H, while at trick 5 (of both games) he would play Queen of Spades, and *B* 3 S, the 6 S and Knave of Spades falling at trick 7 (corresponding to 6 of actual game). *Y* and *Z* would have lost only the odd trick, which, with such wretched hands, would have been getting off easily.

THE TELEPHONE AS AFFECTED BY SOME METEOROLOGICAL PHENOMENA.—Several Continental observers appear to have been lately studying the sounds which may often be heard in a telephone that is connected with a wire stretched, say, between the roofs of two houses, and connected with the water or gas pipes. On the occurrence of lightning, more especially, sounds are heard, and at the same instant (according to M. René Thury, of Geneva) as the flash is seen, whatever the distance of the latter. Even when no thunder was heard, and the discharge must have been at least 35 kilomètres off, M. Thury observed those induction effects. M. Lalagade, who has experimented similarly for some time past, thought to amplify the sounds, and did so by placing two microphones on the plate of the receiving telephone. The arrangement is set up in a quiet room, where all foreign vibrations are guarded against, and the author is able to hear the least sound at a distance of one mètre or more from the second telephone. Again, M. Landerer, at Tortosa, finds currents produced in his telephone-circuit by atmospheric electricity in three different ways. First, the condensation of aqueous vapour results in a sound recalling the cry of tin. A sensitive galvanometer in the circuit is not, or hardly, affected. These sounds are strongest at night. Next, there are the sounds which occur during lightning (and the currents producing which affect a galvanometer considerably). Thirdly, the wind generates currents which do not act on the telephone, but act on the galvanometer strongly. At Tortosa the very dry west winds produce the greatest oscillations. Telluric or earth currents set both on the galvanometer and on the telephone; they are distinguished from atmospheric currents by the regularity and continuity of their action during pretty long intervals.—*The Times*.

XUM

Answers to Correspondents.

*** *Communications which are to receive early attention should be addressed to the Editor of* KNOWLEDGE, *74 and 75, Great Queen-street, London, W.C.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *No queries or replies savouring of the nature of advertisements can be inserted.* 4. *Letters, queries, and replies are inserted, unless contrary to Rule* 3, *free of charge.* 5. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 6. *Each letter, query, or reply should have a title, and in replying to letters or queries, reference should be made to the number of letter or query, the page on which it appears, and its title.*

JOHN HAMPDEN. Let us take it for granted that I am the "coward and sneak" you consider me; "my friend" the eminent naturalist you name (whom I have never met in my life), "a cheat, a swindler, and a shuffling cur," and our learned societies "selfish, dishonourable, and mischievous conspirators." Oblige, also, by noting outside your letters an address to which they can be returned.—EDITOR OF BRITISH CHESS MAGAZINE. Many thanks.—J. BAXENDELL. In saying that the coincidences appear to me to disprove instead of proving your position, I refer to the circumstance that several of them are obviously mere coincidences, existing as such apart from the pyramid or its measures. They show that coincidences of the most remarkable kind can be found in this case, and presumably, therefore, in other cases, by those who look for them, and yet be, to all intents and purposes, meaningless, because accidental. Coincidences, therefore, do not supply that convincing evidence which the believers in what may be called the Great Pyramid religion finds in them.—W. PROBYN NEVINS. You are right; the comet is that of 1680. The comet of 1861, referred to at p. 28, was not seen by so many as the comet of 1858, being conspicuous only for a few days, and in the early morning, whereas the comet of 1858 was for months a brilliant object in the skies. But the comet of 1861 was in some respects even more remarkable.—A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY. You might regard me as "the kettle objecting to the pot its sordid superficies," for, like you, *militavi*; my zeal is tempered now by the consideration that the world is censorious, and easily led to misinterpret warmth as necessarily implying personal feeling. Have we not both found it so? Moreover, most people are more easily pained than I should have thought possible when I first took part in controversy.—S. BIDDLE. It would save me a good deal of trouble to exclude the fifth magnitude stars; but many who use the maps want to have these stars in. It is very easy for those who want them excluded to take pen and ink and put them out.—J. T. LEIGHTON. Occasional papers on quantitative chemical analysis might be admissible, if popular in tone; but at present we certainly have not room for a series of papers on the subject.—J. NORMAN LOCKYER. We regret that you cannot at present spare time. Prof. Young has promised to write on the subject, and your treatment of it from another point of view would doubtless have been interesting to our readers. Perhaps at some future time you can oblige us.—W. SIMONS. The quotation was sent in a letter from an eminent physician. Did not notice the inaccuracy. The lines run, as you say—

Ignorance is the curse of God,
Knowledge the wing wherewith we fly to Heaven.

Thanks for encouraging words in reference to KNOWLEDGE.—J. W. C., AVERILLO. Thanks; corrected in Number 4. We began with the idea of a fortnightly map of the whole heavens, which would have made the pictures too small in scale. In changing our plan the mistake you notice arose, the first, third, fifth, &c., maps being taken with dates and hours, for the second, fourth, and sixth, instead of the true dates and hours.—MAR. S. RIDLEY. Book received, and forwarded to an enthusiast on the subject, for notice.—G. E. BONNEY. Many thanks. The bookseller who thought the public likely to be interested in KNOWLEDGE would be less than we expected has certainly not thus far been confirmed by the event. The sale we hoped to attain in perhaps half-a-year or a year has already been exceeded twofold. Booksellers have a theory that nine-tenths of the journals started from time to time perish at the critical sixth number; possibly when we have reached the seventh your bookseller may have faith in our existence thereafter. We shall see.—J. B., *Norwich Advertiser*. Thanks.—F. C. ARMSTRONG. Your query is not suited to our columns, though legal matters may be regarded as included in knowledge taken in its wider aspect.—P. A. FOTHERGILL, F.R.A.S. Thanks.—EUCLID. We have inserted your query; but though you may be readily shown how to trisect an angle by aid of a hyperbola, or the cycloidal curve called the *trisectrix*, you may depend no one will ever show you how to trisect an angle by use only of the straight line and circle, as in Euclid.—A STUDENT. We are not free to comment on instruments advertised in our columns, but in this case the names of the advertisers stand very high indeed. We feel satisfied that you could rely entirely on any statement their house might make as to the qualities of their instruments.—J. H. HODD. Many thanks. Mr. Foster has some kindred illusions already in hand, and finds the explanation in a peculiarity of Fig. 4 in No. 1. Your illusory picture shall be added to his collection, drawn as you suggest.—H. GRIFFITH. Thanks for encouraging letter.—HENRY NORTON. You are severe, so far as we can make out your letter. Possibly you consider that readable writing and ordinary spelling would have been thrown away on persons so "binevolint" as to cater for "circle squairers, petty schoolmasters, and enquiring schoolboys." Your letter is absolutely alone thus far, and alone among so many, that we venture to conclude you are as exceptional in your views about KNOWLEDGE as in your system of orthography.—JAS. O. JACKSON. On consideration, does it not appear to you that your request is a little unfair? To oblige many readers, we printed the map on a separate leaf. It is thus better printed, our number is enlarged by a full page of matter, and the map is made more convenient for study. As a reward for thus considering our readers' wants, you ask us to go to the expense of having each map separately pasted in. Apart from the consideration that most of our readers prefer to have the map loose, do you not think that your Society could pin or paste the map in? We printed 20,000 copies of each of the last two numbers, and these 20,000 extra leaves added considerably to the cost of those numbers; to have had them pasted in or an extra fold made for each would have involved additional expense, and have been unsatisfactory to many of our readers.—G. W. NIVEN. Your long article on "Clairvoyance" (seventeen very large and closely-written pages of M.S.) would occupy much more space than we can afford even for objects otherwise perfectly suitable for our pages; your subject can scarcely be so described.—E. CL. We shall be delighted to receive your paper on "The Place of Dreams in the Growth of Primitive Beliefs."—ANDREW AITKEN. Thanks for the constructions of parabola, which shall appear if we can make space. First and fourth are scarcely suitable for "Geometricus," being so obviously deducible, one from the definition of a parabola, the other from the fundamental relation between the ordinate and the abscissa, that he could not have failed to recognise them. He wants an easier construction. The two others are in reality one, depending on the proposition that a series of equidistant concentric circles cut a series of equidistant parallels in a series of parabolas, having the centre of the circles as focus, and a line through that point perpendicular to the parallels as axis. There is a similar property for the ellipse, and the hyperbola, equidistant concentric circles replacing the parallels. Diagrams illustrating these relations have already been drawn for KNOWLEDGE, in accordance with promise made at foot of "Geometricus's" letter. There are simpler and better methods than these, however.—M. E. PENDRED. Your first letter does not appeared, because unsuitable. If you are so fearful of science you had better leave it alone. We cannot strengthen your faith; we can only wonder why you are troubled.—JOHN STEELE. Many thanks for proffered M.S. (15 pp. closely written foolscap) in favour of the sun's being rigidly cold, and showing that we are chiefly indebted to water for both light and heat. But—please don't.—HENRY GRIMSHAW. Your illusions next week, if possible. We know nothing ourselves about the Extract referred to; the advertising and editing are distinct departments.—A LOVER OF KNOWLEDGE. Declining and inclining are different matters. The lines of the address, which are really horizontal, appear to decline—that is to be lower down—on the left. As to the other point, we labour under great difficulties with regard to correspondence. We should require twice the space we have, to find room for all. We will do our best to make room early for all that needs early publication, and in the long run for all that is worth preserving.—IGNORAMUS. You misinterpret my remark in "Half-hours with the Telescope." I do not say Mars shows a larger disc or more striking features, but the reverse. What I say is, that we see him on a larger scale; as, of course we do, seeing that he is much nearer the earth. No doubt you were looking at Mars. He is a disappointing object in the telescope.—B. H. THWAITE. Your letter is too long for what, after all, is an exposition of a very unsound doctrine. Take such a sentence as this:—"May not the rings of the planet Saturn be produced owing to that planet having two atmospheres capable of absorbing light from the solar rays?" Without wishing to discourage your efforts at original theorising, or to quote authorities against you, we must yet point out that a study of the facts known about Saturn's rings will enable you at once to decide that your explanation "may *not*" be accepted.—Again we find a great pressure on our correspondence columns. Our own letter, promised in Number 4, was the first sacrificed.

SYNCHRONIZING ELECTRIC CLOCKS.—At the first ordinary meeting of the Society of Telegraph Engineers and of Electricians for the autumnal session, Professor G. C. Foster, president, in the chair, a paper was read by Mr. John A. Lund, on "The System of Synchronizing Clocks adopted in London and elsewhere." Mr. Lund said his paper was an attempt to demonstrate the results to be obtained by even a limited acquaintance with the science of electricity when patiently and perseveringly brought to bear upon some of the practical demands of daily life. The attention of electricians in the early days of their science was, he stated, as much devoted to synchronizing clocks as to message telegraphy, but the repeated failures in the former field, as contrasted with the triumphant successes of the latter, caused the application of electricity to telegraphy to become the favourite path of the electrician. Electric clocks were capable of being divided into six kinds. None of the old forms of electric clocks obtained a general public acceptance, the most successful, the Wheatstone, having only worked some five or six clocks from one motor. Their failure was due to the desire to make the clock subservient to the system, instead of *vice versa*. The criteria of a successful system of synchronizing, to obtain the approbation of the public while receiving the sanction of science, were that each clock should have a vitality distinctly independent of the time signal, and not stop through a failure of the regulating electric current to reach it; universal application to all kinds of existing clocks; lastly, due provision for the correction of errors. The system exhibited satisfied these conditions. Mr. Lund proceeded to say that, however perfect the mode of synchronising might be, it could not be successful without a complete "system." The system consisted of a correct standard clock, which, assisted by a well-erected and well-maintained system of telegraph wires, should send out the needed signals to the synchronisers. Two "standards" were used (one to fall in automatically should the other fail) for transmitting the currents of electricity, and those standards received their motion from a standard clock. The applicability of time current wires for telephone purposes was instanced by telephones being placed at each end of a circuit between the lecture-room (Institution of Civil Engineers) and Messrs. Barraud & Lund's establishment, Pall Mall, upon which wire there were also twelve electric clock synchronisers, through which conversation was carried on.

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